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New Advertisements.

In the growth of THE ELECTRICAL WORLD in circulation, size and general improvement, the value of its columns for reaching those engaged in electrical pursuits or interested in electrical matters has not failed to be appreciated by advertisers. Readers will find it to their advantage to keep their eyes on the advertising as well as the reading columns. The following are the new advertisements in this issue:

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VOL. X. NEW YORK, OCTOBER 1, 1887. No. 14.

WE publish this week a very full report of the meeting held on Monday and Tuesday at Pittsburgh by the National Telephone Exchange Association. This, the ninth meeting, was one of the most successful, and the proceedings will be found full of interest. The able papers of Messrs. Lockwood, Hall, Barney, and Sargent are all well worth reading, and show that telephonic topics still present many points of vital importance. Owing to the distance from New York at which the meeting was held, we are a little late in going to press, but we think our readers will appreciate the enterprise which lays the report before them in this issue.

THERE will be found in the letter of our Western representative this week an interesting account of the situation in Detroit with regard to putting the electric light wires underground. The evidence obtained by the city authorities in favor of their plan for forcing the wires to "go under" seems strong, but it is met by some very weighty counter evidence, as the letter shows, and we all know that the problem of putting the high tension circuits underground has not yet by any means reached its solution. If it had, the arc companies would at once resort to the effective method. In the meantime, however, considerable progress must be reported.

GENERAL BARNEY'S figures, presented at the telephone convention, show a rapidly growing employment of the telephone and a marked increase in the number of subscribers. New York, for example, has 6,881 subscribers, or nearly 900 more than in 1886, and the increase in the daily number of exchange connections is no less than from 42,000 to 84,000—something very striking, and for which it would be interesting to have an adequate explanation. No other city in the country shows an increase at all to compare with it. Thus Chicago had only 11,000 more daily exchange connections in 1887 than in 1886, being an increase from 32,996 to 44,292; and Boston only had a gain of 5,000. The returns from all sections exhibit a gain in subscribers keeping pace with the growth in wealth, population and business. In some large places the proportion of telephones to inhabitants is very large. In such a city as Cincinnati it is 1 in 88; in Springfield, Mass., it is as much as 1 in 59; at Wilkes-Barre it is 1 in 64, and at Atlanta 1 in 48; while in Chicago it reaches 1 in 112; in Boston, 1 in 170 and in New York 1 in 175. Remembering how many people in a single office will use the same telephone daily, and how freely it is visited by "deadheads," it will be seen that a very large proportion of the inhabitants of our large towns and cities use the telephone every day. Indeed, it seems altogether probable that they patronize the telephone more than they do the telegraph.

WE give in another column a synopsis of the decision at Boston, by which the Government or "Pan-Electric" suit against the American Bell Telephone Company has been thrown out of court. The suit in its wanderings from place to place has been very much like Japhet in search of a father, and it still remains without a court it can call its own; while the decision must, of course, confirm the dread suspicion that the American Bell Company owns the whole judiciary of the country. The case first came up at Memphis, then was carried to Columbus, O., and finally was presented at Boston, where the judges record their opinion that the Government has no power to bring any such action. Even if the Government had the power to bring the suit, the court decides adversely against its right to exercise that power in the present matter, since the issue raised can be appropriately and fully dealt with in an ordinary suit for infringement. It is said that the case will be appealed to the United States Supreme Court, but should the Government desire to get rid of a disagreeable burden, it will probably let the subject drop, claiming that it has done its duty and will accept the decision of the Massachusetts court. It is, of course, well understood that this case has no bearing on the appeal now before the Supreme Court and likely to be adjudicated upon next week.

ALTHOUGH the subject of the paper read by Mr. Reckenzaun before the American Institute of Electrical Engineers was not one bearing directly upon electrical matters, yet its relation to a most important electrical development is such that it assumes a first place in the consideration of the problem. To the casual observer the form of gearing adopted on an electric car may seem a matter of small importance, so that, if it be only durable, it satisfies the requirements of practice. But this is far from being the case. The electric railway is throughout an improvement on other methods, and one of its chief claims to recognition is the economy in power which it permits of. Hence, if by the employment of forms of gearing which waste a large percentage of power we vitiate the benefits derived from the electrical appliances, the latter will evidently be of little utility. With regard to the best form of gearing for electric street cars, opinions vary so much that the true solution of the question is evidently still in the future. Individual practice and success seems to be the guide at present, and the result is that forms of gearing heretofore deemed by many as almost inadmissible find application. Such, indeed, is that of Mr. Reckenzaun, but if to his strong testimony we add that of the results of some recent experiments it would appear that the stand taken by that gentleman is, to a certain extent, justified. We refer more particularly to the results obtained in a series of tests made by the Messrs. Sellers & Co., of Philadelphia, adverted to in the discussion, in which it was shown that, *under proper conditions* the value of worm gearing may approach quite closely to that of spur and other forms of gearing. These experiments demonstrated that the efficiency of the worm, long supposed to be far below 50 per cent., may range from 50 to 60 per cent. of the power received. But on the other hand it was shown that in the case of the best cut spur gearing the efficiency ranged between 75 and 95 per cent. These experiments both on worm and spur gearing were made with cast-iron wheels, and hence they allow of no comparison to be made with the relative efficiency of other materials. Mr. Reckenzaun employs a cast-steel worm with gun metal worm wheel, and it is quite possible that under these conditions the efficiency may be still further increased. Another point brought out by these tests and others made by Prof. Thurston, is that the nature of the end thrust bearing of the worm had a large influence on the work lost in this form. So far as experience goes in electric railroad work in this country, both spur and chain gearing have been used with good results.

ONE of the first applications suggested for the storage battery was its employment in connection with a dynamo driven by a wind-mill, the intermittent power of which was thus made available for continuous action in the shape of current drawn from the battery. The idea has not, however, been given the serious consideration which it perhaps merits. This may in part be due to past uncertainty of action of the storage battery, but considering the battery's present status there is no good reason why it should not be employed in the manner signified. It is therefore gratifying to learn that the French Minister of Public Works has commissioned M. Angle-Beaumanoir to conduct a series of experiments at Havre on the use of electricity for lighthouse purposes by wind power, with an arrangement which has recently been patented by M. le Duc de Feltre. For this purpose a windmill 89 feet in diameter has been constructed in this country, and will be sent to Havre and employed in driving a dynamo which charges a set of accumulators, from which the actual supply for the lighthouse is taken. The dynamo, which is shunt wound, is designed to run at a variable speed, while maintaining throughout the whole variation a constant difference of potential at its terminals, this condition being fulfilled by altering the resistances in the main and shunt circuits as the speed changes. It is but natural to suppose that some difficulties will have to be overcome before complete success is obtained, but that a satisfactory arrangement can be devised is beyond question. We know that for some time experiments in the same direction have been made by a well-known electrician in this country, and thus far with considerable success, and it is not hard to believe that the near future will see wind power put to the generation of electric currents to a considerable extent.

ONE of the most interesting questions in connection with telephony is that of its future relationship to the telegraph. We think that a very clear and admirable presentation of the matter will be found in Mr. E. J. Hall, Jr.'s, paper read before the telephone convention at Pittsburgh this week and printed on another page of this issue. Mr. Hall's views are thoroughly statesmanlike, and do credit to his judgment and insight. Several of the points he makes are quite new, and the manner of their presentation goes far to secure acceptance for them, as borne out by facts and evidence, as well as by the general philosophy of things. What he says about the use of one electrical application in educating the public for another and the next is eminently true, and his claim that the telephone served to render easy the work of introducing the electric light has ample substantiation. He might even have extended his remark to include the storage battery. But it is Mr. Hall's assertion as to the competition between the telephone and other means of communication that most calls for notice. In meeting the criticism that long-distance telephone rates are five times higher than telegraph rates, he says: "If the long-distance telephone competes with anything, it is with the railroad, and it does that in the same way and about to the same extent as the local telephone competes with livery stables and street cars." This idea he dwells upon and expands, instancing cases in proof of it and he sums up the whole situation in the remark: "When time is not important, people write letters; when greater haste is necessary, they send telegrams; but when time presses and there is urgent need for haste, they telephone. When the nature of the business requires personal communication, question and answer, the railroad or the telephone line must be used—and this is our field: Quick communication with instantaneous replies and prolonged personal interviews." In the main Mr. Hall is entirely right. The only point that seems to us open for use in the way of reply is that there is competition between the extra-territorial lines and the local telegraph lines, and that this competition appears to be on the increase. He himself calls attention to the fact that "the use of local private telegraph lines, and especially the District Telegraph service, was of special use in preparing the way" for the telephone; and the resort to telephone rather than to telegraph in areas of say 15 miles radius is gaining. Already the delays in such short-distance make telegraphy seem nothing short of prohibitory, and where the telephone can be used it is resorted to in preference, in order to save time. We recommend a careful perusal of the paper, however. It is one of the best the Association has ever had laid before it, and for importance and significance has never been excelled.

Ninth Annual Meeting of the National Telephone Exchange Association.

The convention assembled in one of the parlors of the Monongahela House, Pittsburgh, at 11 A. M., on Sept. 26, and was called to order by the President of the Association, Mr. C. N. Fay, of Chicago.

The Secretary, General Barney, called the roll.

The following gentlemen were in attendance:

Albany, N. Y.—A. B. Uline.
Alton, Ill.—W. E. Smith.
Austin, Texas.—J. K. Dunbar.
Batavia, N. Y.—C. E. Gould, W. Smith.
Boston, Mass.—Thos. D. Lockwood, W. A. Hovey, W. J. Denver, A. V. Garratt, A. O. Morgan. R. F. Ross.
Bridgeport, Conn.—T. B. Doolittle, H. D. Stanley.
Brooklyn, N. Y.—W. D. Sargent.
Buffalo, N. Y.—E. J. Hall.
Cincinnati, O.—E. V. Cherry.
Chicago, Ill.—Geo. L. Phillips, C. N. Fay, C. A. Brown, C. E. Scribner. F. E. Degenhardt, W. A. Kreidler, C. H. Maclilie, E. V. Cavell, J. M. Jackson, W. R. Patterson, F. G. Beach.
Cleveland, O.—J. P. McKinstry.
Denver, Col.—E. B. Field.
Detroit, Mich.—F. A. Forbes.
Elmira, N. Y.—W. N. Eastabrook.
Kansas City, Mo.—C. W. McDaniell, J. W. Ebert.
Louisville, Ky.—H. N. Gifford.
Lowell, Mass.—J. W. Bennett, C. J. Glidden, J. W. Pickering.
Newark, N. J.—C. O. Baker, Jr.
New Bedford, Mass.—Sam'l Ivers.
New Haven, Conn.—M. F. Tyler.
New York.—Clark B. Hotchkiss, G. T. Manson, P. C. Ackerman, G. L. Wiley, R. W. Ryan, F. E. Kinsman, C. E. Stump, R. W. Pope. F. W. Harrington, C. H. Barney, H. L. Storke, J. H. Blaisdell, H. B. Thayer. A. S. Hibbard, J. A. Seely, Geo. L. Beetle, E. J. Hall, Jr., H. C. Davis. H. R. Garden, J. P. McQuaide.
Pittsburgh, Penn.—J. W. Marsh, E. Acheson, H. Metzger, W. A. Connor, W. Adrian, S. A. Duncan, W. J. McElroy, C. H. Jackson.
Providence, R. I.—A. C. White.
St. Louis, Mo.—Geo. F. Durant.
Tonawanda, N. Y.—P. W. Scribner, J. S. Thompson.
Washington, D. C.—S. M. Bryan, J. M. Brown.
Williamsport.—R. M. Bailey.
Harrisburgh, Pa.—J. B. Ker.
Philadelphia.—S. M. Plush, W. T. Westbrook.
Randolph, N. Y.—D. B. Parker.

The secretary then read his report for the year ending Aug. 31. 1887. It showed that the association closed the year with 35 active, 5 associate and 29 honorary members. The secretary's News-Letter had been found of service and in demand. The report of the treasurer stated the receipts as $2,063.12, and the disbursements as $2,025. The Association has no liabilities and it is believed that next year's income will, like that of the last, be sufficient for the expenses.

The treasurer presented a detailed report, the substance of which was stated in the report of the secretary.

Both reports were on motion approved and ordered to be placed on file.

A verbal amendment was made to the constitution, "October" being substituted for "July" in line 2 of Article VII., in order to conform to the amendment made to Article XIV. at the St. Louis meeting, fixing the time when annual dues shall be payable.

The PRESIDENT: Are there any new amendments to propose? There are none.

Now, gentlemen, the hour has arrived for your president, as for every other one acting as the instrument of a cruel destiny, to set in motion the machinery which shall shortly cut off his honorable and, in his opinion, most useful official activities. He must leave his conspicuous position and resume his seat in your numerous, but insignificant midst. (Laughter.) He no longer can occupy this throne from which he can say with Cicero that he sees the eyes of all of you to be concentrated upon him. He cannot longer look upon you with satisfaction—on you who remind him of Euclid's definition of a circle—a curved line, all the points of which are equally distant from a point within called the centre. No longer will some honored representative of illustrated journalism beg his photograph in order to show his constituents next morning "how like a fawning publican he looks," and thus amplify Shakespeare's words, that one touch of art (as well as nature) makes the whole world kin. He might be pardoned on such an occasion if he grasped his last opportunity and seized the one remaining hair on the forelock of time, tied the old fellow's wings, tipped over his hour glass so that its sands should not run against him, and proceeded to swing his scythe so mightily that nothing should remain on the harvest field of rhetoric but endless winrows of imagination and toppling sheaves of eloquence. (Applause.) But on this occasion, impelled by modesty, he will simply say a few last loving words. His expectations of a year ago have not been disappointed.

The business of the year has been larger in volume, I think, than certainly of any recent years in the history of the business. Throughout the country a steady progress has been made in the actual art of telephony. Progress has been made in the directions of service, the permanent construction and maintenance of exchanges, the improvement of switching apparatus, and I think in the general harmony of relations with the public. It is to be hoped that the future will smile upon us as has the past. It is to be hoped that this Association will go on, as heretofore, an instrument of usefulness among us. Its membership has reached in number perhaps its lowest point. The tendency to consolidation of the small exchanges into great corporations co-extensive with the land has apparently ceased for a time, and the forty companies, or some such number, which now occupy the entire telephone field, and which constitute the membership of this organization, will probably not greatly diminish. I think I can say that the association is established, therefore, on a permanent basis, and that its members will, as heretofore, for I see many who have been, as I have, at every meeting of the association since its first at Niagara, continue to come here year after year, and contribute to our information, our progress and our enjoyment. I hope that the officers now to be elected will do their share in bringing about this happy result, and most of all the president whom it is our duty now to ballot for. I do not doubt that your selection will be happy, and that he will far improve upon all his predecessors. I thank you for the honor you have done me twice, and for the courtesy with which you have always treated me in the chair, and I now announce that we will ballot for the next president. May he suit the association perhaps with that identical *t* which is the difference between an *ex*-president and a *next* president. (Applause.)

The following officers were then elected, the secretary being authorized to cast the ballot of the Association in each case:

President: Henry Metzger, Pittsburgh, Pa.
Vice-President: Wm. D. Sargent, Brooklyn, N. Y.
Treasurer: H. L. Storke.

Member of Advisory Committee, in place of W. A. Jackson, of Detroit, whose term of office had expired, E. J. Hall, Jr., New York.

Members of Executive Committee: R. M. Bailey, Williamsport, Pa.; George M. Stone, Cincinnati; J. W. Bennett, Lowell, Mass.; S. M. Bryan, Washington, D. C.

Mr. Tyler proposed the following resolution:

The National Telephone Exchange Association at its ninth annual convention desires to express its sense of the misfortune which has befallen the telephone fraternity in the death of Mr. R. S. Boyd. Mr. Boyd, by his sweet and genial temper, his hearty good nature, and his refined and attractive manners, endeared himself to us all in the performance of the delicate task in which he put his tact and skill, his industry and unquestioned integrity at the service of his employers. In his death we deplore the loss of an honored and helpful member of this association and of a cherished personal friend, and as a token of the esteem in which his memory is held, the association orders that this minute be spread in full upon its records and printed in its published proceedings.

Remarks eulogistic of Mr. Boyd were made by Mr. Tyler, Mr. Metzger, Mr. Eastabrook, Mr. Hovey, and Mr. Storke, after which the resolution was unanimously adopted by a rising vote; and, on motion of Mr. Hovey, the Secretary was instructed to transmit a copy of the resolution to the widow of the deceased.

President Metzger made a few appropriate remarks welcoming this convention to Pittsburgh and expressing the hope that the visit would prove one of pleasure and of kindly recollection to the members.

Mr. C. N. Fay then read a paper entitled "Telephone Subscribers *versus* Knights of Labor."

On motion of Mr. Eastabrook the paper was accepted and ordered to be placed on file.

The Convention then adjourned until half-past two.

AFTERNOON SESSION, SEPT. 26.

The Convention was called to order at 2:30 P. M.

The PRESIDENT: Mr. Phillips has received since dinner the following dispatch from Mr. J. E. Hudson, of Boston:

"Court this morning filed its opinion in the case of the United States against this company in this circuit and our demurrer sustained; government bill dismissed."

This announcement was received with applause, and, on motion of Mr. Bennett, the president and the secretary were instructed to send a telegram to Mr. Hudson congratulating the American Bell Telephone Company "on their success in defeating the government Pan Electric."

Mr. E. J. Hall, Jr., of New York, then read the following paper:

NOTES ON LONG-DISTANCE TELEPHONE WORK.

To talk between points hundreds or thousands of miles apart as though standing face to face is a feat, the accomplishment of which may well call for our best efforts. Apart from all commercial considerations, it presents the fascinations of an unsolved problem. No sooner had the telephone exchange been an established fact than inventors and "promoters" began to suggest all sorts of visionary schemes for long-distance telephone work.

Of the early experiments, none were more successful than the trials between New York and Chicago, speech being transmitted between those points by a number of people with fair results. These trials showed that, under certain conditions, it was possible to talk for a distance of over a thousand miles. We all know, however, that commercial business could not be carried on under these conditions, as all successful tests were made when the wires were free from outside disturbances. As they were clear only on Sundays, and even then only when there were no storms or heavy earth currents, the effect of early experiments was rather to discourage work in this direction.

In Canada and in the Western States some long lines have been operated with success, the distances covered being far in excess of any practical working lines in the Eastern States. The reasons for this have often been discussed in our conventions, and I will not go into them now; it is enough to say that, giving all due credit for what has been accomplished, no large business can ever be worked up on the basis of using grounded circuits, owing to the inevitable "cross-talk" between parallel wires. The first really practical success in talking over long distances was the copper metallic circuit constructed between New York and Boston, by Mr. T. B. Doolittle, for the American Bell Telephone Company, in 1883. The distance was about 300 miles, and I call it the first practical success because it was the first circuit that worked at all times regardless of outside electrical disturbances.

Early in 1885 I was appointed by that company to take charge of the development of this branch of telephone service, and the American Telephone and Telegraph Company was organized to carry on the work. At the outset it was decided that only copper wires in metallic circuits would be used, and that nothing should be spared to make the plant in every respect as perfect as we knew how to build. A builder whose work is known to you all (Mr. W. H. Fairbank) was appointed General Superintendent of Construction and the first line was constructed between New York and Philadelphia. The specifications for this line required the use of poles not less than seven inches in diameter at the top and from forty-five feet upward in length; to be set six feet in the ground on straight lines and seven feet on corners or sharp curves. The poles had gains for seven ten-pin arms, and three arms were at once put on, carrying twenty-four copper wires. In addition to the copper wires, one No. 8 iron wire was strung on a top pin to strengthen the line (especially during construction). The utmost pains were taken in guying and bracing, and the good results of this care in building have been fully demonstrated by the nominal expense of maintaining the line since it was finished.

There are nearly three miles of submarine cable in this line, and all crossings are made with four seven conductor Kerite cables. In three of these cables the conductors are each composed of three No. 18½ B. W. G. copper wires twisted together and insulated to $\frac{1}{16}$ of an inch, and the cables are armored with 18 No. 4 galvanized iron wires. The fourth cable has conductors of three No. 16 wires twisted together and insulated to $\frac{1}{16}$ of an inch, and is armored with 18 No. 2 galvanized iron wires. The cable-houses are large, dry and well lighted, and special care was taken to guard against lightning and against bad connections and leaks in the terminals. All underground and aerial cables are of large conductors, heavily insulated, and the general result has been a line which for nearly two years has worked with uninterrupted success. Wind, sleet, lightning and electrical storms have so far passed over it without causing more than the most trifling damage, and we have secured one of the most essential elements of any factor in commercial business—reliable service.

That this line would "talk well" no one questioned, as the distance (about 100 miles) is far within the limit which previous experiments had shown to be entirely practicable. I will say here that we have not yet reached the limit of distance, but having worked over 400 miles we know it exceeds that. It is probable that the progress of electrical development will keep the possible limit up to the distance over which it will be commercially profitable to supply this service.

Since the completion of the Philadelphia line we have started lines of similar character between New York and Boston (250 miles) and New York and Albany, 160 miles. The Boston line will be ready for service in a couple of months and the Albany line by the end of this year.

Having completed our first line, we were at last in a position, not to commence business, unfortunately, but to work out patiently and thoroughly the problem of making these lines serviceable. Many of you will remember that at our Providence meeting, two years ago, we discussed the question as to whether there would be any serious cross-talk between metallic circuits when we had a large number of them working on the same line of poles. Opinions then varied, but the Philadelphia line showed at once that the interference between metallic circuits was practically about as bad as between grounded circuits. We determined not to offer an imperfect service to the public, and months of hard work resulted in perfecting a simple and practical method of absolutely removing all trouble from this cause. Meantime, the matter of providing suitable apparatus and methods for working metallic circuits quickly and reliably with each other and with grounded circuits at the terminal stations was receiving constant attention, and we now are able to do this work satisfactorily, although this part of our service will always be one in which we may expect continued improvement.

As an illustration of the difficulties encountered: The repeating coil, which gave excellent results when used between New York and Philadelphia, was a complete failure when used between New York and New Haven, and a long course of investigation and experiment was necessary before we discovered the cause and provided a remedy. We have completely reversed the old idea that "Anything is good enough for a telephone line;" now I would say "Nothing is good enough." But a friend suggests that, strictly construed, my statement makes the matter worse. At any rate, the best is not too good, and I am confident that the future experience of us all will convince us, if we still doubt, that the best is emphatically the cheapest in the long run.

The telephone business has now been established long enough to bring us fully into the reconstruction period—the haste of early construction is over, and the problems of underground construction in our larger cities, the general use of cables in all exchanges, the necessity of providing improved switching facilities for the masses of wires which centre in our large offices, and the complicated work of providing quick and certain means of communication between our scattered exchanges are matters which call for the expenditure of lots of brain force and money before the "second construction" gives us a perfected system.

When we look over the history of the development of the telegraph and see the slow and painful progress made by the pioneers of that enterprise, it may well be a matter of surprise and congratulation that the telephone has so quickly found a profitable place in the business world. To a great extent that place had been prepared by the changes in business methods wrought by the railroad and telegraph. The use of local private telegraph lines (and especially the District Telegraph service) was of especial value to us in preparing the way by educating people in using electrical appliances for securing quick local communication.

Undoubtedly the use of the telephone has made far easier the work of introducing the electric light. This process of education is going on at a rapid rate, and the use of private wires between distant cities, which is now so common as to be almost a necessity in certain lines of business, and the extension of our "extra-territorial" telephone lines, is preparing the way for the long-distance telephone.

I am often asked the question, "How can you expect people to use the telephone on your long lines with rates five or ten times as high as the telegraph charges?" The answer is simply this: The telephone has a field of usefulness entirely separate and distinct from that occupied by the telegraph. Of course no one will pay a dollar for a telephone message when he can accomplish the same result by sending a telegram for ten cents: neither will he pay ten cents for sending a telegram when he can accomplish the same result by sending a postal card for one cent. If the long-distance telephone competes with anything, it is with the railroad, and it does that in the same way and about to the same extent as the local telephone competes with livery stables and street cars.

As a matter of fact the service offered by the telephone is something which is entirely new, and when people learn its uses, its place will be just as securely fixed, as a most important factor in the transaction of business between distant points, as it is now in local service, and the railroads and the telegraph companies will not suffer any more than the livery stables and street cars do now from the telephone exchange. When people ship freight for which they are in no hurry, they send it by a sailing vessel or by rail as ordinary freight; when time is of some importance it goes by steamer or by a fast freight line; when goods are perishable or time is important, shippers send by express or by special messenger.

So when in communications time is not important people write letters; when greater haste is necessary they send telegrams, but when time presses and there is urgent

need for haste, they telephone. When the nature of the business requires personal communication, question and answer, the railroad or the telephone line must be used, and this is our field; quick communication with instantaneous replies and prolonged personal interviews. I might give scores of illustrations, but two will suffice: A New York lawyer recently called up by telephone a lawyer in a city nearly a hundred miles away, engaged him for an important case, dictated a lot of legal papers, and inside of an hour was able to file attachments securing for his clients their interest in a large amount of property which would otherwise have been lost. This illustrates one class of service; the other is the case of the Pennsylvania Railroad, which has ample telegraphic facilities between New York and Philadelphia, but in addition, leases a private telephone circuit, so that the officers of the road can, without the intervention of operators and the delay of writing messages, carry on conversation between the two cities.

The contracts for service which we are daily making, and the emphatic commendation of business men who are using our lines, prove beyond question that the long-distance telephone is wanted and that good service will be paid for at rates which will make it profitable to supply the demand. It is just as certain that there is no demand for, and no profit in attempting to furnish poor service, either in trunk lines or exchanges. Just what constitutes "poor service" is a question upon which we may not all agree. I think Mr. Jacques defined good commercial service well in a discussion of this question recently when he said in substance that he considered a good commercial line to be one over which non-experts could converse about subjects with which they were not both familiar, without repetitions. Judged by this standard, how many exchange and toll lines would stand the test?

On motion it was agreed that the paper should be printed as part of the proceedings of the Convention.

DISCUSSION.

MR. DURANT: I would like to ask Mr. Hall to what extent the so-called long-distance transmitter is used in supplying customers with this long-distance service.

Mr. HALL: It is used altogether on our line.

Mr. BAILEY: How many poles to the mile are used on the line between New York and Philadelphia, and is there trouble with sleet storms?

Mr. HALL: About forty poles to the mile is the average. We have had two quite heavy sleet storms since the line was finished. The copper wire stood all right.

Mr. GIFFORD: I would like to ask Mr. Hall what changes are necessary, and if they are very great in adapting our grounded lines or ordinary exchange lines so as to connect with this metallic circuit.

Mr. HALL: The connection between the metallic circuit and the ground line is made through a repeating coil.

Mr. GIFFORD: Can repeating coils be attached to the switch-board commonly in use, the multiple, and can you use the same switch-board and appliances and are the necessary changes easily made?

Mr. HALL: Yes, very easily made.

Mr. BAILEY: Are repeating coils equally practicable at each end of the line?

Mr. HALL: When the repeating coil is at one end of the line the service is very much better than when the repeating coil is used at both ends. The introduction of a second coil seems to bring in quite a serious loss. At the same time, between New York and Philadelphia, where we have good terminal lines, and the instruments are in good order, there is no difficulty at all in carrying on between exchange subscribers in both cities a good business conversation. But if there is any trouble at all in the terminal line, then there is difficulty. The repeating coil seems to reduce the efficiency so far that there is no margin to spare. I am speaking of using the ordinary Blake at both ends connected with the ordinary switch-board at both ends.

Mr. FAY: Suppose it failed at one point,—New Haven, for instance?

Mr. HALL: Well, the explanation of the failure of the repeating coil which worked on the Philadelphia line and did not work on the New Haven line is this. I do not know whether it is absolutely correct or not, but it is a conclusion which we reached. The line between New York and Philadelphia is built largely through a low, wet country. There is a great deal of marsh land, and the line is much freer from earth currents and disturbance than the New Haven line, which is built over a rocky, hilly country, and which has either a greater number or greater intensity of earth currents, or else does not have sufficient ground to relieve the line. The effect of that was, that when we put on a coil with a high static capacity, the earth currents of the metallic circuit were all carried into the grounded line, and by putting in a repeating coil with a small static capacity the trouble was obviated.

Mr. LOCKWOOD: I would like to corroborate or add my mite of opinion to what Mr. Hall has said with regard to the upsetting of the old notion that any kind of a line will do for a telephone. A good many of us can remember the time when the story used to be told in these meetings that steel wire of almost any degree of smallness would stand just as well for a telephone line and would be just as serviceable in the matter of transmission as the best line that could be built, and a great many steel lines of very small gauge were put up and used. I am not disposed to deny that the use of small wire did enable the line fiend to get into a great many places, and I think for that reason very possibly suburban work was materially advanced. A little later, some of us will remember, the theory was broached that insulation was superfluous in telephony. One gentleman went so far as to advocate putting up long lines, 30, 40, and 50 miles long, without any insulators whatsoever. A great many did not go so far as that, but they put up the porcelain knobs, of which I may have a word or two to say in a special paper. Porcelain knobs are still sometimes used, and they have a function where they are protected from the weather and where the line wire is covered, but they are certainly not of any use where the line wire is bare and exposed to the weather. Instead of assuming that as the telephone will work as well as it does under adverse conditions, over a bad line, over a leaky line, over a line with bad joints in it; instead of taking for our text the story that the telephone will work over any kind of a circuit, we have reached the point where we must assume that the telephone current is a small thing at best. Again and again we have heard that the current generated by the telephone is not much more than the one-millionth part of the current of a Daniel cell, and we have got to start from that point and realize that we cannot make its conditions of transmission too easy. Hereafter, when we put up a subscriber's line, every one of us has got to understand that that line may be a possible link in a long line of communication between two or between three or four adjacent cities. Instead of being only connected occasionally through an exchange switch-board to another line of equal length or approximately equal length, we have got to regard it as one end of a very long line, perhaps two or three hundred miles long, which has a link of like character at the other end of it, and we must not forget that the two ends are the most important parts of the line of communication. It does not matter how good a line we have in the middle, how good a line we have in the 50 or 60 miles which extends between the two subscribers that are talking—if the ends are bad, the whole is bad. And so I think that it may be emphasized, and it cannot be emphasized too frequently, that the short exchange lines have got to be well built; they have got to be built in just the best way we know how; the line wire must be good; the insulators must be good; the joints must be made in the best way. It does not do only to put glass insulators as far as we think a man will go and look at them. I remember a line which was recently built for a gentleman of my acquaintance, and he specified particularly, because, as the linemen said, "he was a very particular man." He specified just the kind of a line he wanted, and the General Manager of the telephone company unquestionably agreed with him that those conditions were highly necessary for a line, and gave the necessary orders. The line was built, and when the subscriber that it was built for came home and looked at it, he found that although he had specified glass insulators it was put up on porcelain insulators. He brought that fact to the general manager's notice and the general manager agreed with him, as would be expected, and said that he had given orders—and I know that he did give such orders—that the line should be built just as well as it could be. But he again gave orders that the porcelain knobs should be taken down, and that the line should be insulated with glass. The lineman went and insulated that line with glass just as far as he thought that subscriber walked back over his line, and he left the knobs on the rest of the line. But we have got to give the best attention to the ends. I think that if we have got to have a bad link in the line of communication anywhere it is better to have it in the middle, and have the ends perfect. Ground connections we must look after sharply. I think a ground connection should be inspected frequently. If you put a ground connection around a gas pipe or a water pipe, and the water man or the gas man goes to it, he does not ask us whether that is a ground wire, and it is all he will do if he twists it around and leaves it. Very frequently he does not do anything to it. Therefore, I think that is a point that might be insisted on in exchanges—the frequent inspection of ground wires.

Mr. HALL: One little incident occurred last week that I think will prove interesting of which Mr. Hibbard tells me; in calling up for Boston over our new line, which is now completed as far as Springfield, Mass., about 175 miles from New York. The line was connected through a repeating coil on a copper wire between Springfield and Boston, about 100 miles further, so that the line as made up was 175 miles of metallic circuit and 100 miles of ground wire connected through a repeating coil. The 100 miles of ground circuit was very noisy. Mr. Hibbard was for that reason unable to make the man in Boston understand what he was saying, but he was able to understand clearly every word that the Boston man said. The Springfield man, who was in on the grounded circuit, could not hear the Boston man talking to him, and Mr. Hibbard in New York talked to the Springfield man and told him what Boston was trying to say to him. The effect of the repeating coil was to screen out the noises of the grounded circuit apparently, and while the direct current which went into the metallic circuit from the Boston transmitter was not very loud, it was perfectly clear and distinct, so that he heard without difficulty everything that was said in Boston. He says that he could have carried on a long conversation, or could have taken down a newspaper article or anything of that kind from dictation. But the man who was 175 miles nearer to Boston and on the direct circuit could not hear Boston.

Mr. LOCKWOOD: Mr. Gifford asked how their induction coils were made and how connected. A great many of us have had practice with these coils and know that the coil is simply an ordinary induction coil differently constructed; that is, while there are two wires each one is alternately the primary and each one is alternately the secondary; it depends on which way the transmission is going. Each of the wires of course has two terminals or screw posts, and the two terminals of one wire are connected with the two ends of the metallic circuit, while in the other wire one screw post is connected with the line and the other with the ground terminal of the exchange line.

Mr. SEELY: Have you reference to the induction coil or repeating coil?

Mr. LOCKWOOD: I had reference to that species of induction coil which we call a repeating coil.

MR. GIFFORD: We have all had more or less trouble with bad connection and in the last few months I think I have had more trouble with bad connection in our Louisville exchange than I had before in eight years, and I find that some solder joints are just as bad as some of those that are not soldered—not so many of them—probably three soldered joints to one that was not soldered gave out. I would like to make an inquiry in regard to these new connectors that Mr. McIntire, of Newark, N. J., I think, has a patent on. Those connectors are two little tubes soldered together, and you run the wires in and then twist them. I am using them and they work very nicely. I have used them only a few months. My opinion is that they are going to be better than any other connections we have ever had. A good soldered connection is a good thing, but I find it is almost impossible to get a man who will go out and solder connections unless you go and stand over him with a club. If those other twisting connections will answer the purpose, we will probably, by using them, get our lines built better. I would like to know if any one has used those connections, and what the experience has been with them. If anybody has any information on that subject, I would be very glad to hear it.

Mr. HALL: Those McIntire connections were designed originally for our long-distance lines. Before we adopted them we had a thorough test made at the mechanical department of the McIntire joint. These tests included the britannia joint soldered and the American twist joint soldered, the joints all being made by good linemen. Probably they were better joints than would ordinarily be made in practice, particularly as to the solder connections. The McIntire joints showed that we had the full strength of the line wire in the joints. The other joints fell off from 15 to 25 per cent. I have forgotten now which was ahead, but the best showed a loss of at least 15 per cent. in the strength of the line wire; that is, the break was always at the joint and at a pull of 15 or 20 per cent. less than would break the wire itself.

We have used the McIntire joints since that time exclusively and they have given us entire satisfaction. I apply those joints to both iron and copper wire.

Mr. LOCKWOOD: I think there may be difficulty experienced if they are applied to iron wire, that is, the conductivity may be much impaired within a few months on account of chemical action between the two metals.

Mr. GIFFORD: The holes of the tubes fit very snugly over the wire and it makes a very tight connection and it is better than anything we have used. I have not soldered joints on iron wire. I used iron tubes on the iron wire and copper tubes on the copper wire.

Mr. SEELY: I think it would be advisable if all the connections that could be gotten into the switch-board were of platinum. Steel plugs rust, brass plugs wear out very rapidly, and platinum plugs can be made very cheap, and I think they would help the service very much.

Mr. BAILEY: In the last year we have been fitting up a lot of bells with a small switch of our own manufacture, in which we use platinum points and platinum plates. We have fitted up probably two hundred to three hundred bells, and I have not found the first one to fail us yet. I think that if that was carried all the way through in switch-board connections and everywhere, it would save a vast deal of money in inspection and give a vast deal of comfort and satisfaction in service.

President METZGER expressed the hope that those who make apparatus for telephone exchanges would bear in mind the suggestions made by Mr. Seely and Mr. Bailey.

The secretary then presented the usual paper on

EXCHANGE STATISTICS.

The paper consisted of a large number of tables. That of exchange subscribers showed New York to have 6,881; Chicago, 4,577; Brooklyn, 3,297; Boston, 2.130; Baltimore, 2,105; Philadelphia, 2,420; Pittsburgh, 2,286; Providence, 2,417; Washington, 1,362; Buffalo, 1,767; Detroit, 2.585; Cincinnati, 2,900; Milwaukee, 1,732; Minneapolis, 1,387; Louisville, 1,661; St. Paul, 1.025; New Orleans, 1,148; New Haven, 1,227; Albany, 1,258. No figures were obtained from Kansas City, San Francisco and a few other large cities. New York it appeared has just doubled its subscribers since 1882, and in this respect is nearly paralleled by Chicago. The number of daily exchange connections in New York is 84,750; Chicago, 44.292; Cincinnati, 45,000; Detroit, 33,146; Brooklyn, 17,508; Boston, 17,345; Baltimore, 19,275; Philadelphia, 17,098; Pittsburgh, 18,492; Minneapolis, 16,000. The daily calls per subscriber average in New York 12.3; in Cincinnati, 15.5; Richmond, 12.9; Detroit, 12.8; East Saginaw, 13.0; Minneapolis, 15.5. The number for New York last year was only 6.5, indicating an increase of work for the exchange, per subscriber, of nearly 100 per cent. The number of subscribers' wires per operator was 157 in New Orleans; 84 in New York; 84 in Richmond; 95 in Boston; 98 in Baltimore; 80 in Washington. New York had 755 trunk lines; Chicago, 369; Boston, 213; Brooklyn, 221; Cincinnati, 260; Jersey City, 69; Pittsburgh, 78; Providence, 39. New York showed a gain of 155 trunk lines over 1886. New York had 43 daily connections per trunk; Detroit, 155; Reading, 76; Worcester, 80; Louisville, 40; Pittsburgh, 69; Chicago, 75; Williamsport, 48. In the matter of exchange wires, Providence showed 322 "direct" and 675 "circuit;" St. Paul, 469 and 210; Washington, 478 and 300; Worcester, 57 and 215; Minneapolis, 579 and 281; Portland, 45 and 316; Hartford, 176 and 193; New York; 6,842 and 8; Philadelphia, 1,897 and 132; Baltimore, 1,078 and 372. The cost of one connection in New York was .0078; in Philadelphia, .0037; in Brooklyn, .0041; in Chicago, .0040; in Denver, .0055; in Washington, .0037; in New Orleans, .0018; in Minneapolis, .0016.

As to "lost connections," the secretary said:

"Milwaukee for the third year reports the heaviest number of lost connections, which is for this year 15.2 per cent. This, however, is much smaller than last year, when 34 per cent. was reported. New Haven, which did not report for two years past, shows the same percentage as Milwaukee. New York makes the remarkable claim that its 'missed calls' only amount to 2,658 *per week* out of a total of 84,750 calls per day. Counting only six days to the week, this percentage would be about *one-half of one per cent.*, which seems almost incredible, but, as some one has previously remarked, 'figures won't lie,' and these figures have been verified by personal inquiry at the office of the general superintendent."

It was ordered that the report be embodied in the printed proceedings of the Convention.

Mr. SEELY: As the gentlemen of the Convention seem to be amused at the small number of lost connections in New York, I would say that in New York when a man calls for a connection and the party he calls for is not in his office at the time, we make a note of it, and ring him up afterward. It may possibly be 20 minutes after the call that the connection is made. If the subscriber called for cannot be raised the operator makes a ticket, which is filed on a hook. The tickets go to the chief operator, who is instructed to try to get those connections through afterward. If they succeed in getting those connections during the whole day, of course they do not count them as lost connections.

Mr. DURANT: The connection is not lost until the day is lost; it is good till sundown.

Mr. LOCKWOOD: It is a realization of the old adage—nothing is lost if you know where it is.

Mr. Lockwood then read the following paper, entitled:

TEN YEARS OF PROGRESS IN PRACTICAL TELEPHONY.

The year 1887 marks a decade from the institution of the first experimental telephone exchange, and it seems an eminently proper time for a retrospective glance through the various and transitional conditions through which the telephone exchange system as a whole has passed on its way to the present period and degree of excellence.

Ante-Telephonic Exchange Systems.

It is fitting at this point that your attention should be called to the fact that the idea of electrical intercommunication is older than the electrical telephone. There is no space in this paper, and not time enough at this meeting to recount in detail the special features of these ante-telephonic exchanges, but the paper would be incomplete without at least a glance at them. The first idea of exchange work which to my knowledge occurs in history is found in a British patent issued as far back as Feb. 7, 1851, to F. M. A. Dumont. This clearly describes an exchange system of dial telegraph instruments, connecting by short lines with branch central stations, which branch stations were provided with trunk lines connecting them with a principal station. Some of the substation lines converged directly to the main central station. Mr. Dumont showed two forms of switch-board; in one form the lines were connected by flexible conductors having hooks at their ends, and to unite two lines it was only necessary to bring two hooks together.

I show here a picture of the system of lines. The second form of switch-board comprised a number of dials with switches revolving on a pivot at their centre, the switch representing a line to be connected with other lines, which latter were represented by metal studs arranged round the switch dials. The idea was far ahead of the times, and I do not know whether it ever went into use.

At a later period after the British Post-Office had assimilated the telegraphs of that country, and while the telegraph was still the only means of electrical communication between place and place, the plan of inter-communication between sub-stations by means of a switch at a central station was used in England at various places. The post-office used it at Colchester for the ordinary business between several small towns in that district, and between them and London; and at Newcastle between persons renting private lines; in the former case the Morse sounder was used for signaling; in the latter the Wheatstone dial was employed. In our own country it is well known that large telegraph offices have been almost from the introduction of telegraphy fitted with switch-boards whereby different lines could be interconnected. This was, however, in such cases merely a secondary function, and such interconnections were chiefly used for the purpose of patching defective lines, for putting several lines together longitudinally to constitute temporarily a long through line, or to arrange for some president or general superintendent, who at a watering place or summer resort would upon occasion desire to converse telegraphically with his confidential clerk at the home office.

The very essence of the electrical exchange business is, on the contrary, the continual inter-connection of the various lines. But notwithstanding this difference in function, it is quite obvious that the entire American system of telegraph has been from the beginning a colossal aggregation of central offices for telegraphic communications, possessing switch-boards for changing and coupling circuits, electrical apparatus for sending signals, apparatus for receiving signals, and devices for either establishing through communication between two wires, or terminating one or more circuits at the earth.

In 1869, the Gold & Stock Telegraph Company established an exchange system of printing instruments between a number of the banks and the Clearing House of New York, which existed in different forms until the telephone made its appearance.

Immediately after the war, Mr. Henry Bentley established a system of inter-communication at Philadelphia, the lines of which were classified as "Telegraph Exchange Financial and Commercial News" "Bank lines" and "Private and Local lines."

Scores of business houses and firms were so connected telegraphically at will, through a general central office, that they were enabled, whenever desirable, to transact business telegraphically with each other or with the central station.

Morse keys and sounders were used in this exchange, and the connecting operator at the central station had not only to connect and disconnect the lines, but also to arrange the batteries as the length of combined line varied.

Next comes the Exchange system of the Law Telegraph Co., which was organized in the spring of 1875.

It was the result of an idea of Mr. Wm. A. Childs, to whom is due the credit of working it up.

This company operated in New York, and placed both a dial telegraph and a call bell, and a Morse key and sounder at each subscriber's station. The dials and bells were on private wires converging to a central station, and a number of Morse instruments were in circuit together upon a call wire, also extending to the same central station, much the same in the general way as is the case in the present so-called "Law" system. At the said central station was a switch-board and a set of trained operators to work the same.

The call was sent in by repeating numbers on the Morse circuit.

Early Telephone Exchange Work.

The telephone, as we all know, was patented in 1876. It achieved its first great success at the Centennial, and the second telephone patent was issued on Jan. 30, 1877.

That its applicability to the purpose of inter-communication was from the first appreciated, is abundantly proved by contemporary records.

I myself remember being present at a lecture given by Professor Bell at Chickering Hall, New York, in May, 1877, where, although there was a good deal of doubt in my mind about the actual existence of a real Watson at the other end, and though the major part of the exhibition feature of the lecture consisted in "waiting for Watson (?)" I clearly gathered from the words of Mr. Bell that in his mind the telephone was to be used as the operative instrument of just such systems as we have now, and whereby houses could be enabled to connect with the butcher, the baker, the candlestick maker if desired. This impression of the lecture I have always retained with particular sharpness, by reason of the *sotto voce* remark of a jealous Englishman immediately behind me, who upon the statement made by Prof. Bell, said with profound disregard of the rights of the letter H, "I suppose each 'ouse hadded to the circuit would be about one home." He evidently meant one ohm, but as he stated it, the proposition was indisputable.

The first telephone line actually built for the purpose was finished on April 4, 1877, and extended between the office of Mr. Charles Williams, Jr., at 109 Court street, Boston, and his house at Somerville, Mass.

The First Telephone Exchange.

In 1877 Mr. E. T. Holmes was carrying on an electrical burglar alarm business at 242 Washington street, Boston. He had a number of lines already in existence. Telephones were placed at the offices of a number of the subscribers to this system, and by means of a switch-board purchased for the purpose by Mr. Holmes, the lines were upon the 17th day of May, 1877, and thereafter, repeatedly placed in inter-communication, the connecting link being simply a double flexible conductor with a central office telephone at all times in the circuit.

Calling was done in both directions by means of the burglar alarm apparatus.

This was later discontinued because the subscribers were not willing to pay for the luxury, as the telephone was then considered.

The next historical telephone exchange was located in the drug store of Isaac D. Smith, at Hartford, who leased a lot of telephones from the New England Telephone Company and constructed a series of lines from a number of doctors' offices and livery stables to his store, furnished the said telephone to the said doctors and stablemen, established a home-made switch and call bell in his store and was in the habit of connecting the doctor's lines to one another and to the stables, as they might be called for. This exchange was brought into some local prominence, as a railroad accident occurred one night during its existence at Tariffville on the Connecticut Western Railroad, and the news coming to Hartford, the doctors were collected to go out on a special train, by means of their telephone, upon call from Mr. Smith, much quicker than they could have been otherwise. But Mr. Smith died and made no sign, and his embryotic exchange was merged into the Hartford exchanges.

The Commercial Telephone Exchange.

The first city of the world to open a commercial telephone exchange was New Haven, Conn. This was opened to the public on Jan. 28, 1878. The moving spirit in it was George W. Coy. Its establishment was rapidly followed by that of a similar exchange at Meriden, by E. B. Baker, the latter being opened on Feb. 14, 1878.

From this time onward we cannot in this paper follow the history of individual exchanges, but must be content to generalize. It suffices to say that exchanges at Lowell, Albany, Hartford, Holyoke, Springfield, Newport and New York were quickly organized, and the Telephone Exchange idea was successfully established.

The Era of Competitive and Reckless Construction.

In the year 1878 the Western Union Telegraph Co. seem to have reached the conclusion that the telephone business would be profitable, and they took a hand in it and organized exchanges with a good deal of enthusiasm in many of the cities throughout the United States, in competition with the exchanges operating under the Bell telephone license.

Looking back we can think and truthfully say that, although such competition was severe for those engaged in it, it became a means for spreading the use of the telephone widely over the land, for the wide establishment of the telephone exchange, and for accustoming the public to the frequent use of the telephone, which no other agency could probably have equaled. The ultimate result was that by the end of the competition in 1880 nearly every important city and town in the United States had a telephone exchange.

But there was another result. Such a competition implied usually that the exchange which fully occupied the ground first held a great point of vantage against the other, which need only be lost by absolute neglect, consequently there was a fierce and extensive rivalry in the construction of lines and in making low rates, which we are still suffering from. The cry was, "Cover the ground! Get your lines up: give us good construction, if possible, but give us the lines, good or bad." We know now that many of the lines built on this principle were bad.

Rates were given, upon which the lines certainly had to operate at a loss, but the business was new and this was not seen until later; $36, $24, $22 and nothing per annum were charged. So far as I am aware Pittsburgh and St. Louis only began work at remunerative rates.

The Western Union exchanges were mostly fitted with switch-boards recommended by that company, most of them having the board known as the Universal Jack-knife switch. This was a flexible cord board. The lines were usually worked on the closed circuit or battery principle; being built chiefly by old telegraphers, the lines were usually well constructed, of good galvanized iron wire of sizes varying from No. 9 to No. 12, and were well insulated upon glass or rubber hooks.

The telephones comprised an almost infinite number of styles of Edison transmitter, and half a dozen styles of magneto telephone. Exchanges organized by the Bell telephone interest also chiefly adopted a cord and spring-jack switch-board, known as the Williams Standard. Some of us are yet in the harness who remember this board and its groups of connecting strips, painted with all the hues of the rainbow, and causing the historical coat of Joseph to pale with envy.

But in the larger cities many more of the lines were fitted with magneto bells—there was but a single style of receiving telephone; and for a transmitter we had, firstly, the box telephone, and from the beginning of 1879, the Blake transmitter. On the other hand, I have reason to believe that the lines constructed by the Bell exchanges were not as substantial as those of the opposition. The wire used at that time was nearly all No. 12 galvanized iron; and the insulators were too frequently regarded merely as fastening attachments. While the glass insulator and rubber hook were freely used, the porcelain door-knob attained also an undesirable prevalency.

It will be seen that each side had advantages as well as disadvantages. The Bell people had an excellent magneto bell and generator, which, in fact, has proved so serviceable that its general style to this day has suffered no exchange; and a tower of strength in the fewness of their styles of telephone; towards the last, in the Blake transmitter, which could be efficiently operated with the lips at a distance, in contradistinction to the Edison instrument, which, though more powerful, had to be operated with the lips close to the mouthpiece—a proceeding not always pleasant.

But the Western Union people had more experience, and, as a rule, better lines.

Consolidation came along in due course of time, and a new era commenced—an era of rapid and legitimate growth; but the growth was too fast for good work, and was so tremendous that it deceived many of us into believing that the same rate of increase would last forever.

The Plug Switch-board Era.

The next stage in central office history which is to be referred to I have called the plug switch-board era, because in the first place I don't know what else to call it; and because in the second place a revolution about this time seemed to sweep over the land, flexible conductor boards going into almost complete disuse, and plug boards being almost universally favored.

I should, however, have stated that during all the previous history of the exchanges quite a number of the exchanges had developed switching systems of their own—all, of course, having the same ultimate aim and function, but accomplishing the said functions in different degrees of efficiency. These systems were each and all admired by at least one man. The deviser quite naturally thought there was no exchange system like his; and in truth, he was generally correct in that idea. But this circumstance long proved a bar to uniformity, and was not likely to be a convenience when the time came to connect exchanges; for the manifest excellences of our neighbors' board were not so manifest to us.

But the fruits of ill-considered and reckless construction and low rates began to be apparent. As stronger companies were formed they naturally formed executive committees. The strong points of the average executive committee of an electrical corporation are an innocence of electrical knowledge, an inability to distinguish between the two words "economy" and "parsimony" and an indisposition to see that a dollar properly expended to-day means a good many saved throughout the year. Money was scarce; the lines must go up, and the cry was heard, "We must have a cheap switch-board, and cheap lines." The cry was heard, and we got a cheap switch-board—a plug switch-board. I think that though the Gilliland plug switch-board was, so far as electrical connections went, by no means in the ideal condition of Cæsar's wife, it was still a necessity of the times. It answered well in the majority of cases; it was easy to understand, easy to handle, and everything about it was accessible. It was a great educator, and on the whole I think it was perhaps, for the reasons stated above, a better switch-board to have round than others more perfect, electrically, would have been.

Its chief weakness was a looseness between the plug and its socket, but it must be confessed that this fault was plain to be seen, and in the power of exchange managers to rectify. Unfortunately many of them did not see the importance of rectifying it; and I have been in Central offices where I could give a good blow with my breath and blow a couple of dozen plugs out of their places.

A worse habit developed in this era; the habit of assuming that because the telephone would work as well as it does under the most adverse conditions we might therefore ignore the most ordinary precautions: give it a hard steel wire of any gauge from 14 to 20 to work over, insulate our lines with glass, rubber, porcelain knobs or nothing; neglect to solder ground connections or joints, and apparently try in every way to make it as difficult for the telephone current to exist as possible.

The fine steel wire mania, it is evident, grew up from the need of strong lines, and as it was seen that steel was strong, the second idea was that as lines multiplied, available space to bestow them became scarce, and, of course, by using a fine or small wire we were enabled to put up a great many in a small place. Besides, when I go to Jones and tell him I want to attach a wire to his house, he'll let me much quicker if I show him a small one.

But the porcelain knob lunacy is not so easily accounted for. I suppose, first, the unsophisticated exchange man assumed that the only use of an insulator was that of an attachment; that he later undertook to study electricity and ascertained that porcelain was a non-conductor; and that thereupon he jumped to the conclusion that all porcelain articles must be well adapted for line insulators. How was he to know that the efficiency of an insulator depends as much on its form as on its material? That may be the way the door knob got into the saddle. It stays there because it does not cost much.

By 1882 wires were so multiplied as to be inconvenient. Cables were introduced, and here again we have had to be educated up to the proper point. When first introduced we most frequently found in them a No. 26 conductor, no special insulation and a wrapped external coating of doubtful durability.

In that year, also, the electric light industry began to assume importance, and we began to see that wherever a telephone wire and an electric light wire came into close conjunction with one another, the weakest went to the wall.

This lesson could not, however, be learnt until an object lesson was given, and the Boston central station had to be practically destroyed before this subject was seriously considered and proper measures taken for the prevention of such evils. In 1882 the American Bell Telephone Company and the Western Electric Company came into harmonious relations, and this paved the way for the improvement and completion of the multiple central office switch-board, and for the beginning of its general introduction into the larger exchanges.

During the period which has elapsed between that year and the present time, the wheel of telephonic preference has again swung round; switch-boards having plug connectors have in a great measure gone out of favor, and flexible connection switching apparatus is once more preferred.

The Telephone Exchange of 1887.

And at the present time the majority of the larger exchanges are fitted with the multiple switch-board, some degree of uniformity being thus secured. Look at the average exchange of the year of grace 1887, and then judge whether great progress has not been made during the decade, and also during the latter five years.

It is now almost universally recognized that it is a good practice to conduct all, or as many as possible, of the converging wires into the central station by cables, and also to use cables to carry a number of wires to the district intended to be served. This idea has largely been utilized during the last five years. By its adoption 3,000 lines can easily be conducted into an exchange, where otherwise it would be difficult to introduce 500. Nor is the advance in the number alone of the cables employed; where six years ago the size of the conductor and the character of the insulation were hardly considered, we now recognize the necessity of proper electrical dimensions, a high ratio of conductivity, a first-class insulation and plenty of it, and a durable protecting envelope. If, as is in some cases true,

these conditions are not obtained, it is not because their necessity is not recognized, but because the purchasing agent or the person or persons controlling the exchequer is by nature incapacitated from perceiving that in our business the best is also the cheapest.

Many of the exchanges of to-day are working a number of underground wires. By this practice we have all been educated. Some of us took the honors of underground wires spontaneously, others have had those honors thrust upon them. It cannot be denied that these underground wires show a certain amount of sluggishness in their working, but I do not think that inductive interference between wire and wire has been increased by the bunching of wires underground. Where interference has been intensified it has usually been traced to absolute leakage occurring at junctions between the underground and overhead sections, or in test boxes, or working vaults.

Our progress in underground construction must teach us the necessity of eternal vigilance in construction, especially as regards insulation. While I would not unnecessarily bury wires, I would get the necessary rights and franchises as much as possible, so as to be ready at any time.

The first-class exchanges of 1887, in addition to being fitted with lightning arresters of proved virtue, are likewise provided with some form of protector against the destructive effect of dynamo currents; and it is gratifying to observe that some exchanges at least are beginning to see the necessity of protecting both ends of the line, a proceeding which will be remembered, I strongly advocated in my paper last year. An excellent form of protector for this purpose has been devised by Mr. I. H. Farnham, of the New England Co., which consists, broadly stated, in using the heat developed in the bell magnet coils to spring a circuit changer which, according to its construction, opens or grounds the circuit or shuts the apparatus.

In our earlier years it was customary even in large cities to connect more than one instrument upon a circuit; and this practice gave rise to a number of inventions intended to individualize the signals, so that only the station called would hear the signal. But these, while curiosities of electrical gymnastics, could not always be relied upon, and our experience of to-day shows that, wherever attainable, for a number of reasons the best individual signal is an individual line.

Another decided advance is the widespread recognition of the fact that intermediate bell magnets or auxiliary bells exercise a much greater retarding effect than is due to their resistance alone. This leads us to the conclusion that we must cut down the introduction of electromagnets as much as possible, and to the further conclusion, that where they cannot be dispensed with, their helices should be connected in parallelism; wound with coarser wire, or shunted by a differentially wound resistance or by a condenser.

We may also, I think, congratulate ourselves on the almost universal use in heavily worked offices of power generators or automatic pole changers. Where five years ago only our largest offices possessed these labor-saving appliances we now find them almost everywhere, and when we consider the ease with which power may now be made available, since we have to choose from the water motor, the gas engine, the electric motor energized from an adjacent dynamo, or the battery and pole changer, it would seem blameworthy to allow any heavily worked office to go unsupplied.

It seems at this point fitting that I should call your attention to the care of the American Bell Telephone Co., which not only through its principal patents protects the main portion of the business, but continues to purchase from time to time such inventions as promise to be useful to its licensees.

The patent which covers the constantly operating generator or pole changer is a case in point.

Inter-urban lines and other long lines have, during the history of the exchanges, wonderfully increased both in number and length; and with the general introduction of copper wires, more powerful transmitters and greater intelligence in the users, are giving very satisfactory service. The use of the copper wire I regard as one of the most important advances in our history, and it is with considerable satisfaction that I once more point out that Mr. T. B. Doolittle, in advance of the age, strung a hard-drawn copper telephone line in Ansonia, Conn., in 1878, and has always been the persistent advocate of copper line wire. It is proper, also, that I should call the attention of the association to the fact that the greater efficiency of copper lies not only in the lower specific resistance of that metal, but also and chiefly in that it has a very low coefficient of self induction, or, in other words, a very small amount of magnetic inertia.

Lines are, I think, as a rule, better constructed now than formerly, and the advantage of giving the telephonic current a better path to travel over and good insulation to retard the escape of the electrical excitement seems to be better appreciated than ever before. As to the service of to-day I prefer to say little. I think nearly every exchange is better fitted to give good service, and further that the majority of exchanges do give good service. It is, however, true that good service needs close watching, as the best staff of operators require discipline and constant supervision, and I think the person in charge of the operating room should in all cases be a male. First. Because the chief should understand the electrical arrangements intellectually, and it is rare to find a woman capable of such an understanding.

Secondly. Because I think operators will be more readily amenable to discipline when exercised by and insisted upon by a man.

Looking back upon the entire field, we cannot fail to see that though sometimes it has not been easy to observe the progress from day to day, progress has certainly been made; for we are far ahead now of the point where we were either ten or five years ago. We have, however, to make further advance. It is not enough to know that small wire is not conducive either to stability or to good operation; it is not sufficient to know that a porcelain knob is not an insulator; it is not enough to realize that each company ought periodically to test its lines with the galvanometer, and to test for trouble with the same instrument, in the hands of a competent electrician. It is not sufficient to know that competent electricians require more than sixty dollars a month; that line-wire joints and ground connections ought to be soldered; that every part of your plant ought to be periodically inspected; that in your business the best supplies are always the cheapest. It is never sufficient only to know the right way. What possible avail can it be if the right thing is not done in the right way, by the right man and at the right time? "If we know these things, happy are we if we do them."

Mr. DURANT stated that the St. Louis exchange had started at $100 a year on a three years contract and that the rates were the same to-day.

Mr. BAILEY moved that the paper of Mr. Lockwood be published in the proceedings of the meeting and further that the hearty thanks of the Association be tendered to Messrs. Fay, Hall, Lockwood and to Gen. Barney, for their able, interesting and instructive papers. The motion was carried.

Mr. HALL: I want to emphasize one point that Mr. Lockwood made, and that is that you cannot get a competent electrician for $60 a month, and I think that one great difficulty with the telephone service to-day is that we have not a proper corps of men trained in the duties of their respective positions. We need better help all through the service, and it is necessary in order to get men to pay them. We are not training up young men in the business. The material that is coming into the telephone service is not what it ought to be to give the best results and provide the men who in the future are to fill the responsible positions in our companies.

Mr. FAY: In reference to Mr. Lockwood's statement as to the effect of electro-magnets, I do not think that any member of the Association can do a better thing for himself and his service than to get Van Rysselberghe's treatise on the use of electro-magnets in his simultaneous system of telegraphy and telephony over the same wire. By the use of electro-magnets and condensers Van Rysselberghe was able to diminish the effect of a Morse current upon a wire over which the current passed to such an extent that he could introduce a telephone in the same circuit and carry on conversation without being interrupted by the Morse current, although the Morse signals were passing at the same time; an effect due entirely to the retarding influence of the electro-magnet on the battery current as it came on the line. What an electro-magnet will do with a Morse current it will do with a telephone current.

The PRESIDENT read a letter from the Westinghouse Electric Company, inviting the members to visit their works. On motion of Mr. Bailey, the President was instructed to accept the invitation with thanks.

The meeting then adjourned until ten o'clock Tuesday morning.

SECOND DAY'S PROCEEDINGS.

The convention was called to order at 10:25 A. M.

The secretary read letters of regret at absence from Capt. George M. Stone, of Cincinnati, and from Mr. W. A. Jackson, of Detroit. Letters of invitation to visit their respective works were read from the Oliver & Robert Wire Company, Limited, and from the Allegheny County Light Company. On motion of Mr. Eastabrook it was agreed that the thanks of the association be extended to those two companies.

The next subject taken up was the selection of a place of meeting for next year. The secretary read a letter from Mr. J. M. Bennett inviting the Association on behalf of the Erie Telegraph and Telephone Company to hold its next meeting at Minneapolis. A letter was also read from Mr. Henry C. Davis, president of the Electric Club of New York, inviting the association to hold its next meeting in that city, and tendering the full privileges of the club-house, No. 17 East Twenty-second street, to the delegates in the event of the meeting being held in New York. Messrs. Seely, Fay, Sargent and Hall spoke in favor of holding the next meeting in New York, while Messrs. Bennett and Lockwood favored Minneapolis. On motion of Mr. Eastabrook, the secretary was instructed to call the roll of delegates, each delegate, as his name was called, to indicate the place he favored. This was done, and it resulted in the selection of New York by a vote of 14 against 10 in favor of Minneapolis. The time of meeting was, on motion of Mr. Eastabrook, referred to the executive committee with power.

Mr. A. V. GARRATT then called the attention of the convention to the valuable wire gauge table compiled for the National Electric Light Association, and presented in THE ELECTRICAL WORLD of Aug. 20.

Mr. BAILEY: I move that the thanks of this association be tendered to Mr. Garratt for his able discourse on the subject of gauges.

The motion was carried.

Mr. LOCKWOOD: It appears to me that there are two points which cover the entire ground of the question; the first of these is, that every gentleman ordering wire should know what kind of wire he wants. The corollary of that is that every manufacturer when he undertakes to fill an order for wire should know what kind of wire the person that orders it wants. That brings me to the second main feature, which is the necessity whereby telegraphic orders can be sent with few words—concise and clear. It seems therefore that the full use of a gauge is that it shall be something which shall express intelligently and intelligibly what kind of wire is wanted, and the size of the conductor, and that we also need to know what material is wanted. It seems, therefore, simply to come to this, that if we can get a series of numbers and letters which shall express unmistakably the kind of wire that is wanted, and if we can get gentlemen to make use of that common code, all that is wanted is done. I find that I cannot altogether agree with Mr. Garratt further. Everybody here in his boyhood learned long measures—that three barley corns make one inch, 12 inches one foot, etc. I have heard it said that this metric system is a decimal system, and that sooner or later we must come to a decimal system—that we must be ready to take the system of the future. It seems to me that while we are thinking of the future we must also live in the present. We have got the inch before us and there is no more reason why we shall not express fractions of an inch decimally than fractions of a metre. Thousandths of an inch have grown into regular use as the unit for ordering wire by. It is very easy if we want to know the sectional area to square the diameter. I find that we just as frequently want to know the diameter of the wire as the sectional area. If then we have the sectional area and want the diameter, we have got to divide or make some other arithmetical calculation which will give us the diameter. Squaring the diameter to get the area is, I think, easier than to get the diameter from the area. The great point in favor of the thousandth of an an inch is that we are all accustomed to it. Another point against the metric system is that if we take the millimetre as a measurement of sectional area or diameter, and do not measure the length of the wire by that system, we are measuring the cross section of the wire by one system and the length by another. If we keep inches and yards and miles for length, I think that we should stick to the same system for sectional area and diameter. At the same time I would like to add my word of appreciation of this table. I think it is an invaluable addition to the literature of the electric age. All of it is work that is good work, and we can rely upon the figures.

Mr. SARGENT said that he had done some work in connection with the wire gauge for this association, and what made the question very tiresome to him was that after adopting it hardly a single member of the association, he believed, had seen fit to use the gauge. He believed that only himself and one other gentleman in the whole United States, were consistent with the declaration of the association and used the gauge. He thought the common-sense view of the situation was that it would be a comparatively simple matter for any user of wire to say that he would use one particular gauge of the three well-known and recognized gauges. He did not see that we needed to do away with the ordinary wire gauge and its convenient numbers.

Mr. DOOLITTLE: It is now simply a question of convenience in ordering by simple number whether to use the Birmingham gauge or the Brown & Sharpe, and I recommended the Brown & Sharpe, for the reason that it has been adopted by the manufacturers of brass and copper wire, and in ordering wire we simply have to designate the kind of gauge. Of course it is utterly impossible to promulgate any kind of wire gauge and say that it shall be used, particularly in our department, for electric wires are a very small proportion of the total consumption of wire. It is impossible to bring the whole trade of wire to a common gauge, but we can order our wire by thousandths of an inch, and while that would not agree exactly with the numbering, it is near enough so that we can designate it, say a No. 14 or No. 12, or what not, and it will answer the purpose. If I was going to suggest anything I should suggest that the members in ordering wire should designate the gauge.

Mr. R. W. POPE, after describing the difficulties growing out of the present mode of ordering wire, said: I propose the following system: That all existing gauges be tabulated in progressive order, from the smallest size to the largest in use. This table could embrace every existing gauge. To each size thus specified assign a carefuly selected code word of such a character as to be free from liability to telegraphic or caligraphic errors. Such a table would permit a single word to indicate any existing size of wire according to any gauge now in use. As an example of the proposed system, hastily prepared, I submit the following:

No. 20 American—Apple.
No. 20 Birmingham—Banquet.
No. 20 Standard—Salad.
No. 20 Washburn & Moen—Wagon.
1,000 circular mils—Mammoth.
8-1000 of an inch—Travel.

A similar code is already in use by manufacturers of iron pipe for the exact specification of sizes and qualities.

Mr. W. D. Sargent, of Brooklyn, read the following paper on underground work:

UNDERGROUND WORK.

In my remarks on underground work last year the style of our creosoted wooden conduit was fully described.

In the latter part of December, 1886, in consequence of the passage of an amendment to an existing ordinance by the Board of Aldermen, the Commissioner of City Works refused to issue permits for opening the streets. For this reason our underground work has been at a standstill. We had submitted plans for 1887 for six miles of creosoted wooden conduit which were approved by the Subway Commissioners, but, for various reasons, an application to the courts for a mandamus has been delayed until now, and a decision is expected in the next few days. The Dorsett conduit, five miles in all, connecting Brooklyn and Williamsburgh, when completed, proved to be very defective. The faults in it are due to several causes, but chiefly to carelessness in laying it in the ditch and making the joints. After a great deal of work, occupying all this year, the ducts are now reported ready for occupancy. The Dorsett material is very rough, and at the joints it squeezed through the cracks, making projections that were broken off in the process of clearing out, and brushes had to be run through to clear these pieces out. Even now the ducts are so very rough that a lead cable is badly scratched in hauling in. It was claimed this material was gas-tight, water-tight or even mud-tight; all of these things have been found in the ducts and manholes. The only explosion of gas we have had in Brooklyn was in a Dorsett manhole. Recently the elevated railroad people exposed about 8 feet of the first creosoted wooden conduit we laid three years ago. There is not the slightest decay externally and the ducts inside are clean and dry, the friction rollers running as smoothly as when first laid. Looking backwards, we feel that, had we to do the work over again, we should enlarge the ducts to 3 by 3 inches inside and double or treble their number because we now see that, with increased diameter necessary in cables and the use of double conductors, our space will soon be exhausted.

We had expected to be able to lay six miles of conduit this year, which would make a total of 20 miles. This work was prevented by the conflict of authority between the Subway Commissioners and the Board of Aldermen. No change has been made in our plans for distributing and we expect to do this from terminal poles and housetop fixtures. In the business portion of the town we are able to secure places for fixtures without much trouble, but among residences it is very difficult. We have carried the cables to housetop fixtures, in one case by going through the cellar to the rear of the building, then up the wall to the fixture on the roof. We have a cable box in the cellar and run all wires in use for that from there. In two other cases we have run a galvanized iron pipe up the face of the building alongside the water spout, and through this carry the cables to the fixtures for distribution.

We are in communication with the elevated railroad people for the purpose of carrying cables and wires on their structure for distributing purposes. No terms have been made yet.

The Brooks cables, covered with pure lead, have now

been in service three years. The corrosion of the lead pipe noted last year is still going on, with indications that it will take several years more to reach the insulated wires. The Western Electric cables, lead with a small percentage of tin, placed in the same conduit at the same time, show only a thin, hard white scale, with no indications that it is increasing. The N. Y. & N. J. cables, covered with lead and tin, have been in the conduit about nine months, and they show no corrosion beyond a thin scale. I think we may assume that a composition of lead and tin resists the action of the gases in the underground conduits. We now have 18 cables, aggregating 1,700 conductors, leading out underground from our Brooklyn central office; 939 of these conductors are in actual service; six cables, aggregating 500 wires, leading out from the Bedford office; 175 of these conductors are in actual service.

We have, all told, 16 miles of cables underground, 1,500 miles of conductors, 900 miles of which are in actual service.

The cables leading out from the Brooklyn Central office range from 900 to 7,180 feet, in Bedford from 460 feet to 2,250 feet.

The first cables furnished by the Western Electric Co., 100 wires mixed indiscriminately, have been in service since November, 1884, and have given satisfactory service, with one intermission on account of defective terminals. This difficulty seems to have been solved by their last devices for that purpose and no serious decline in the insulation has occurred for the past two years.

The wire used in all our present cables is .035 to .038 inch diameter, with insulation .075 to .088 inch.

Realizing that metallic circuits will be necessary in underground work, all our cables were ordered twisted in pairs or groups of four. Through a misunderstanding a portion of the cables were furnished indiscriminately.

We now have cables with the conductors related to each other in three different ways.

It was found at once that the cross talk between two of a pair, or two of four, was too great for satisfactory service. There is no cross talk between the pairs or the groups of four.

One cable of 7,160 feet, 100 wires twisted indiscriminately, of the Western Electric manufacture, has some cross talk, but not enough to prevent its use, and 84 of the 100 wires are in active service. The insulation of the cable varies from 650 to 450 megohms in summer, and the capacity is .227 microfarads per mile.

The next in length was made by the N. Y. & N. J. Tel. Co., 6,660 feet, with 100 wires twisted in pairs. The cross talk between pairs was so bad we were compelled at once to take measures to remedy it. The joints were opened and the pairs broken up at all the manholes at intervals of about 800 feet. The effect of this work was to reduce the cross talk between pairs and distribute it among all the wires. It may be expected, of course, that more frequent transpositions would make the cable just as good as the Western Electric. This is not practical, and we shall restore the wires to their original relations, grounding the twin wire until the metallic circuit era arrives. The insulation of this cable ranges from 54 to 29 megohms per mile and the capacity is .3 microfarads per mile, Thirty subscribers are working through it.

The shorter cables give similar results, diminishing proportionately to the result.

To connect our Brooklyn central with branches at Bedford and Williamsburgh will require 2½ to 3 miles of cable, and we believe if we followed the Western Electric type then there would be enough cross talk to make them valueless, or if we ground the twin wire in the N. Y. & N. J. tube we believe there will be retardation enough to make serious trouble. We have therefore decided to make our long trunk lines of copper .050 in diameter, and insulation .125 in diameter. This reduces the copper resistance nearly one half, and increases the thickness of the insulation. Sixty wires of this size may be put in 1¼-inch core, making a cable with an outside diameter of 1¼ inches. We are restricted to this size by the 2-inch holes in the Dorsett conduit.

Owing to the delays caused by the action of the Board of Aldermen none of this cable has been made up to show what its electrical qualities will be.

The insulation of the Western Electric cables quoted shows there has been no reduction since the last terminals were put in. The N. Y. & N. J. cables do show loss of insulation, but we attribute this to the joints and terminals, our men lacking skill and experience. This will improve this, and, other things being equal, we believe both cables will give good results.

We believe it economical and desirable to have employés capable of doing all kinds of cable work, including joints and terminals, and have two men under instruction for that purpose.

A 25 wire okonite cable was drawn into the creosoted wooden ducts in the summer, when it was removed to make room for more wires. There is no sign of deterioration or decay in the rubber, and the insulation is 150 megohms per mile in water since it was taken out of the conduit.

It is generally believed that rubber cables will be damaged or destroyed by laying in creosoted wooden ducts, unless protected by lead. It would be interesting to make further trials to demonstrate whether this be so. For terminal wires leading from the conduit to the building some form of rubber or gutta percha wire is the most convenient.

We expect to remove our Brooklyn central office to a new building as soon as we can get permits to open the streets. All our wires will be brought into this building underground. The new office will be equipped with the latest improvements in multiple boards, including metallic circuits.

I have received the following letters from Boston and Chicago, relating to the results of the underground work in those cities.

There is a great want of knowledge among users of cables as to the best forms, size and dimensions necessary to be able to predict with reasonable accuracy what results may be expected from any given length of cable.

The results obtained by the American Telephone and Telegraph Company, in operating long distance communications by means of large copper metallic circuits and improved transmitters, has brought into prominence the necessity for a higher degree of efficiency in exchange work.

It would seem as though enough experience has been had, if formulated properly, to guide our efforts to higher efficiency with this end in view. E. J. Hall, Jr., of the A. T. T. Co., recently invited a few telephone men living in the neighborhood of New York to meet at his office for the purpose of discussing the subject of telephone cables and making an effort to define the qualities that are needed for good work.

Dr. Jaques, electrician of the American Bell Telephone Company, read a very interesting paper on the results obtained on a very large number of lines varying in length, resistance and capacity, and from these results offers a formula for calculating the requirements for good commercial talking to any required distance.

His definition of a good line is very good, although I think many exchange lines would be disqualified by his standard.

It is that when two persons not experienced telephone experts are able to carry on a conversation without repeating or at least no more than speaking face to face.

He believes that the readiness with which telephone conversation may be carried on depends on first, the total electrical resistance of the circuit forming the two stations; second, on the total electro-static capacity of this circuit.

That no matter what may be the distance between two points, good business conversation may be carried on between them, provided they be connected by a pole line or cable, or both, the product of whose total resistance by its total capacity is less than 2,000 for Blake transmitters, and 4,500 for the Hunning transmitters.

He claims that by this formula it is possible to write a specification for any line it may be desired to build. This formula applied to several lines leading out of New York City seemed to prove its truth.

The specifications for a standard cable meeting all the requirements of telephone work are confined within narrow limits, on account of the necessary multiplicity of wires and lack of space in all large cities.

Mr. J. P. Davis, consulting manager of the American Bell Telephone Company, states that .125 of an inch is all that can be allowed in New York City for one wire. After a full and free discussion of the electrical and mechanical difficulties of underground cable work it was agreed that all cables whose wires occupy the space mentioned, namely, .125, should have not more than 35 ohms resistance, and .20 microfarad capacity; the wires to be of .035 to .050 diameter insulated to .125, which gives about No. 8 B. & S. gauge, should be twisted in pairs and laid up in eccentric layers, reversing the direction of each lay.

During the time these conductors are used o n grounded circuits the twin wire would be kept grounded, operating as a shield against cross tack.

It was also agreed that the best way of wiring new multiple boards is to make them up for metallic circuits at once, placing one ground, as long as they remain, in the subscriber's office and the other at the point where the twin wire ends.

Realizing the importance of the conclusions arrived at by the conference, the Metropolitan Company has decided to wire its new colossal board in this way, and the new switches for Buffalo and Brooklyn will be wired in the same way.

This will place the central office on a loop, which can be completed at any time metallic circuits are available, and makes the transition from ground to metallic circuit gradual and easy.

Mr. BAILEY having asked for information as to the process by which Mr. Sargent spliced his cables, the president called on Mr. Patterson to give a description of the method.

Mr. PATTERSON: The only thing to look out for in making a joint in a lead-covered cable is to keep out moisture. The ends of the cable, after the cable is made, should always be sorted out. Then after the cable is drawn into a conduit the end of the pipe is cut off and the pipe removed from the core for a distance back corresponding to the size of the cable. For 100 wire cable we would want to strip about 18 or 24 inches on each end. On the new style of cables arranged for metallic circuit, each pair of conductors are twisted together and served with a single splint of cotton. The serving around the two wires will hold them in place until the man who is doing the splicing deliberately removes it. One is covered with white cotton and one with red and white, or some color that can be easily distinguished. The two wires are brought together, and the way we generally make a splice, and the best way I think, is to strip the wires for an inch and a half, bring them together, and instead of making a long splice, bend them up and then twist the ends together. That will leave the wire running through and the two ends twisted together standing at right angles to it. A cotton sleeve is drawn over it. This sleeve is like the outer braiding of office wire. After all the wires are spliced in that way they should receive a bath in very hot paraffine, poured on while they are laid out loosely, to remove moisture which they may gather from the atmosphere and from the hands of the men. Then the core should be covered and brought down to a compact size, so that the lead sleeve will slip back over it. After that sleeve is on it should receive another paraffine bath. After the work is all done it is well to take a torch or something of the kind and pass it along underneath the cable and melt the insulation for a distance of one or two feet each side, so as to put on a pressure and test the joints, and if there is any flaw it will show itself by the paraffine oozing when the pressure is put on. Occasionally in underground work it is not convenient to make a sleeve pipe. In that case we turn both ends of the cable up and bring them out through the top, and have a brass casting in the form of an inverted Y. The two branches of the Y are of such size that the cable pipe will slip into them, and the main outlet is large enough to make the splice. The wires are brought up through there and spliced together, and the opening covered by a cap, either an ordinary pipe thread screwed in, or, if it is larger, by a flange and bolster on the outside. After the work is done, that Y is dropped into the hole and lifted; that removes the necessity of doing the work in the man-hole. It is lifted up to the level of the street, and the man sits on the edge with his feet inside, and works on it.

Mr. SEELY: In New York City the Metropolitan Company have something like 18 miles of underground cable. It consists of three different systems—the Edison, the Brooks and the Western Electric. We have nine miles of the Western Electric in Sixth avenue. The longest length is two miles. We have had one explosion with the Dorsett system. The conduit is very rough, scratching all the lead pipe from the cables when they are pulled through. We have no trouble in making our underground joints; we let the Western Electric do that for us, but on our aerial cables we have a plumber who makes those joints, as Mr. Patterson has described. The only difficulty we have had with any underground system has been with the Brooks system. A short while ago 400 wires failed. We traced it to the the terminals where there was some water. We were compelled to draw the cable out and boil it. It worked well after being put back. Our insulation ranges from 500 megohms to one megohm. The Brooks system measures very much lower than that. The longest length of the Brooks is 1,900 feet. The static capacity ranges from $\frac{18}{100}$ to $\frac{18}{100}$ microfarad, and on moderate insulation, say, one megohm per mile.

The PRESIDENT: What is the result of your investigation in regard to Brooks' cable as to cross talk?

Mr. SEELY: There is some cross talk in Brooks' cables. I never saw a cable yet but that there was some leakage or cross talk. We are compelled to ground all the wires that are not in use. Of course that cuts down the cross talk considerably. The president of our company has decided to use metallic circuits in the future for all our subscribers. Our cables will consist of the No. 18 Browne & Sharpe gauge, with a static capacity of $\frac{31}{100}$ of a microfarad. Instead of putting 100 single wires in a cable, we are going to put 100 metallic circuits in a cable. As the subscribers' lines are gradually turned into metallic circuits, we will use the wires and we will ground one side of the circuit until that time comes. We have cables in New York City, No. 14, No. 16, and No. 18 American gauge. We talk as well on a No. 18 wire as we do on a No. 14. We have no underground cables under 20. We have 20 miles of Patterson cable of No. 20 and 26 wire. We also have some long kerite cables. The static capacity ranges from $\frac{25}{100}$ to $\frac{30}{100}$ of a microfarad. We have a cable running from our testing house to Mr. Sargent's exchange in Brooklyn, which has been there some sixteen months—a Patterson cable. I think that it is a No. 14 cable. They are grounded circuits. Our original intention was to use them as metallic circuits some future day.

Mr. E. J. HALL, JR.: There has been an impression that we might after a while take out our cables and rearrange the connections so as to adapt the present grounded circuits for metallic circuit use, but a little reflection will satisfy any one that that is not possible, when you come to think of the complications involved in doing any work on cables underground, and then imagine a conduit filled with lead cable. On the cable running through Sixth avenue, New York—about two miles—we tried the experiment practically of working a cable 2½ miles long, which is giving good results when used for grounded circuits. As a metallic circuit cable the line worked so badly that we asked Mr. Eckert to take the conductors out of the cable and give us some overhead wires, which he did. and the trouble was removed. The difficulty was simply this: In working a grounded circuit through a cable. indiscriminately, 2½ miles long, you have 2½ miles of exposure of the conductor to interference from other wires. When you bring the return conductor back through that cable you have 4½ miles exposed to induction from single wires for the reason that the wires in the metallic circuit are not affected equally by the disturbance. They are not parallel and they are not made up with reference to the other wires in the cable. You start in at one end with No. 1 and No. 2 wires immediately adjoining, but at the first joint the wires have been taken up so that they do not continue in the same parallel relation.

Mr. SEELY: The present condition of our underground cables, of course is not satisfactory; if it were we would not go to the enormous expense of giving every subscriber a metallic circuit. We have more electric lights, more telegraph wires, and more of all kinds of induction in New York than anywhere else. Induction does not come from the underground cables, it is brought into the cables from the overhead wires.

Mr. E. J. HALL, JR.: I would like to make one statement further, which I think may interest you. We recently worked a line between Philadelphia and New Haven, about 175 miles, in which there were about 18 miles of cable, that cable being made up of aerial, underground and underwater, 15 miles of that was continuous at one time. That working on metallic circuit has been operated with entire satisfaction. So I do not think that we need fear in any of our cities that we will strike a limit over which we cannot talk successfully, even though we used cables entirely.

Mr. BENNETT: Was that an experimental test?

Mr. HALL: Yes, sir.

Mr. BENNETT: It has not been practically tested by subscribers, has it?

Mr. HALL: The cables were connected up for the purpose of making this test?

Mr. BENNETT: What will that do practically when you have got 50 subscribers in a 100 conductor cable to a metallic circuit?

Mr. HALL: It will work just exactly as well if the cables are constructed with reference to using metallic circuits.

Mr. BENNETT: The men who are putting their money in telephone stock want to get the best possible appliances they can to continue the business practically. Two years ago there was nobody talking metallic circuits. You state in this convention that you have got so many miles of wire. You have got a subscriber 100 feet from your exchange. You tell us he is on a metallic circuit; that is 200 feet of underground work for that one subscriber. Why not simply say that you have so many subscribers, and it takes so many miles of wire to those subscribers?

Mr. SEELY: I stated emphatically that our cables were in miles—18 miles of underground cable—not wire; longest length, 2 miles; shortest length, 1900 feet.

Mr. BENNETT: How many subscribers have you got on those wires?

Mr. SEELY: Three thousand.

Mr. BENNETT: How many wires in a cable?

Mr. SEELY: From 100 to 400.

Mr. BENNETT: How many wires for the 3,000 subscribers?

Mr. SEELY: Three thousand.

This brought the discussion to a close and the meeting adjourned.

After the convention adjourned the delegates boarded the steamer Mayflower and enjoyed a delightful sail up the Monongahela to Braddock, where the Edgar Thomson steel works are located. Several hours were spent in inspecting the process of manufacturing steel rails, through the courtesy of Messrs. Carnegie Bros. & Co, Limited, represented by Mr. W. P. Palmer. On the return trip to Pittsburgh a beautiful collation was served on the boat.

The pleasure and comfort of those in attendance at the convention was greatly enhanced by the thoughtfulness

and generous hospitality of Mr. Henry Metzger, who left nothing undone that could in any way promote good feeling and render all perfectly at home. The delegates showed their hearty appreciation of his efforts by a vote of thanks presented on the boat, through Mr. Tyler, and to which Mr. Metzger replied.

EXHIBITS.

The following is a list of the exhibits at the convention:

The Western Electric Company showed one section of single cord multiple switch-board, magneto bells, etc.

The Standard Electrical Works exhibited magneto bells, power generator, head telephone band and the McDaniel switch. A magneto bell manufactured by this company in November, 1878, was shown in contrast with the modern bells, there being nine less connections in the latter.

Mr. Clark B. Hotchkiss exhibited samples of kerite insulated wires and cables for aerial, underground, submarine and other uses. Also samples of kerite tape.

The Standard Underground Cable Company exhibited samples of their insulated wires and cables for submarine, underground and aerial purposes; also samples of their new "Acheson" compound cables designed for metallic circuits.

The Okonite Company exhibited a large number of samples of their various insulated wires and cables for aerial, underground, submarine and office use. Also samples of their "okonite" tape.

The Guion Automatic Heat Co., of Elmira, N. Y., was represented by W. N. Eastabrook, who exhibited a furnace regulator designed for coal, steam, or gas heat.

The Eastern Electric Manufacturing Company exhibited 1 50-line telephone switch-board; 2 5-line sections of multiple system; 1 10-line toll line board.

The principal feature of this switch-board is a mechanical device which works automatically connected with each annunciator, which opens the line when the subscriber calls "Central." By means of this arrangement the subscriber calling the central office is notified that his call is received, by his bell, which ceases to ring. If, on the other hand, his line or instruments are in trouble, his bell continues to ring. Thus each subscriber tests his own line every time a call is made. This automatic device at the annunciator also serves as a lighting arrester. When a call is received upon the switch-board the apron of the annunciator falls and strikes a blow which opens the line, and is automatically replaced. The visual signal consists of a knob with the number of the line upon its face, which projects beyond the position of the knobs of the lines which are not in use. The two five-line sections of their multiple system embody all the features of the above-described boards. The multiple principle consists of a normally open leg running from each annunciator within reach of every other operator on the board, by means of which each operator can automatically remove the ground of the called subscriber. The toll line board is a combination ground and metallic circuit without the use of plugs, cords or pegs; the telephone and generator circuits are both looped in. This board is so arranged that one or both annunciators can be shunted at the operator's pleasure. The result of this device is that there is practically a solid wire connection between the lines in use to the movable terminals which are rubbing contacts.

Electro-Magnetic Machine Tools for Shipbuilding.

The first successful examples of these electric machine tools, which have already been described in our columns, are the electro-magnetic machines introduced by Mr. John McMillan, Sr., into the practical work of his shipyard, at Dumbarton, from which, on May 19, 1887, was launched the screw steamer Albania, having a portion of the rivet holes in her shell drilled by these machines. After a very small amount of practice, the men working the machines drilled the ¾-inch holes in the shell with great rapidity, doing the work at the rate of one hole every 69 seconds, inclusive of the time occupied in altering the position of the machines by means of differential pulley-blocks, which were not conveniently arranged as slings for this purpose. Repeated trials of these drilling machines have also shown that, when using electrical energy in both holding on magnets and motor amounting to about ¾ horse-power, machines have drilled holes of 1 inch diameter through 1¼ inches thickness of solid wrought iron, or through 1⅝ inches of mild steel in two plates of $\frac{13}{16}$ inch each, taking exactly 1¼ minutes for each hole. Another machine, which has magnets of less holding power, when using only about 0.6 horse-power of electrical energy, took the same time to drill holes of $\frac{11}{16}$ inch diameter through wrought iron of $\frac{13}{16}$ inch thickness. As regards speed of drilling, the author believes these results are equal to any obtained by machines using much greater power. With a hammer using an electro-motor giving out one-half brake horse-power, from 100 to 150 blows per minute have been obtained, with a force of impact equal to about 180 foot-pound, per blow, as nearly as could be ascertained. This is much greater than the force of blow given by hand hammers weighing 6 pounds and striking as heavily as is possible in staving up. At the works of Messrs. Immisch & Co., in March last, this riveter was seen closing 1-inch rivets in 10 seconds each. The electro-motors used by the author in the machines constructed for Mr. McMillan, with which these results have been obtained, were of Messrs. Immisch's design and manufacture, and the writer believes they will not readily be surpassed. After seeing the machines at work in Messrs. McMillan's yard, Messrs. William Denny & Bros. constructed an electrical drilling machine having a modification of the traversing frame, but without holding-on magnets, and applied this machine to drilling the rivet holes in the butt joints of a large steamer.

On Electric Street Cars; with Special Reference to Methods of Gearing.*

BY A. RECKENZAUN, C. E.

Scarcely nine months have passed since your esteemed president, Mr. T. C. Martin, presented a paper on "Electric Street Cars" to this American Institute of Electrical Engineers. I have read this excellent paper with interest, and I have learned a great deal from it, as also from the discussion which followed. Mr. Martin compiled some very important statistics regarding the number of horse cars in actual use in the United States, and he computed them to number 25,000, for the propulsion of which no less than 120,000 horses are requisite.

These figures filled me with wonderment and surprise, and when I read further on, that over 20,000 of these noble animals are rendered useless every year with overwork in street railway service, I felt it to be the duty of every engineer, electrical or mechanical, to assist with every means in his power in the emancipation of the horse from such cruel service. The percentage of loss given in the paper referred to agrees closely with our European experience. We know that the natural life of a street car horse is reduced to about four years, although it never works more than four hours a day. It seems barbarous, therefore, to employ animals for such purposes; yet until recently no economical substitute could be found. Steam, compressed air, gas and spring motors have been tried and found inefficient. Improvements may be made in one or more of these, but at the present moment the field of enterprise is entirely open to the cable and to electricity. There are over 80 miles of cable roads in operation in the United States, more than half of which have been laid down within the last five years, and there are indications that further and rapid progress will be made with this mode of traction, particularly in hilly districts, where it is impossible to apply self-propelled cars, owing to the want of cohesion between the wheels and rails when the angle of repose is approached.

On ordinary streets with gradients of not more than 5 per cent., electric traction will doubtless be more economical and far more convenient than cables, for well-known reasons. Not only is the first cost of construction far cheaper than the cable and its conduit, but the efficiency of the electric system is much greater.

It is admitted that on cable tramways some 70 or 80 per cent. of the total available power is consumed in dragging the cable itself, leaving a maximum of 30 per cent. for moving the cars, whereas with electric transmission over 50 per cent. can be utilized, as will be seen by the following figures, which I have obtained from experiments on the electric railway at Frankfort in Germany. This line is worked by the overhead conductor system. Its total length is four and one-tenth miles, double track and grooved rails. The entire circuit of the conductor is eight and one-fourth miles long, and its electrical resistance was calculated to be 1.6 ohms.

EFFICIENCY AND WORKING COSTS.

During the experiments referred to, two cars were propelled at a speed of seven and a half miles an hour; one of these cars had an electric motor, and the other was an ordinary car attached to the first, and the entire weight was ascertained to be 8.35 tons, including passengers. Electrical measurements were taken from the dynamo at the power station simultaneously with those on the car. The rails were in their usual dirty condition. When running on the level road the energy used on the cars was 3.87 horse-power, and on the generating dynamo 6.47, giving an efficiency of 59.82 per cent.; when traveling up a grade of 1 in 45, the motor gave eight horse-power and the dynamo 13.5, which again correspond to 59 per cent. of the available electric energy. These measurements do not include the losses in the dynamo and motor, but it must be remembered that only two cars were on the road, while the capacity of the plant at the central station was sufficient for 14 cars. With 12 cars running under the ordinary circumstances of traffic, the steam engines were indicated, and this showed a maximum of 164 horse-power, consuming two and three-fourth tons of coal per day of 15 hours, or two and one-half pounds per indicated horse-power per hour. Reduced to car miles, the weight of coal came to 7.5 pounds, which, at three dollars a ton, would cost one cent per mile run.

The Frankfort Electric Railway has carried over 3,000,000 passengers since its opening in April, 1884. The working expenses in the year 1886 amounted to $24,904, including the following items:

Salaries of directors, superintendent, engineers, electricians, conductors, drivers, firemen and laborers	$13,615
Repairs of roadway, rails, cars, machinery and buildings	5,088
Fuel (coals and kindling wood)	3,955
Oil and waste	831
Lighting and heating of buildings, lighting of cars and streets	1,415
	$24,904

The rolling stock consisted of fourteen cars, all of which were used on Sundays and holidays, but only eight cars were usually running on week days. If we take an average of ten cars, then the entire expenses would amount to $6.82 per car per day, but not more than one-third of this, or $2.27, can be reckoned for the item of traction, which should only include wages of engineers, electricians, firemen, cost of coals, oil, and repairs to machinery.

There are about a dozen electric railways in successful operation in Europe, some more extensive than the one I have just described, some smaller; but this one in Frankfort is worked at a greater expense than any of the others I know of; it has been in continuous use for nearly three and a half years, and I thought that by giving you detailed and exact figures of *one* line, I would serve your purpose better than by attempting to crowd a few generalities of all our electric tramways into the small compass of a short paper. You can take this as a safe standard of comparison with other systems of street car traction.

It will be observed, with justice, that the dynamos and motors of the Frankfort line, which was projected more than four years ago, do not yield as high an efficiency as more recent machines. This would leave us another margin. It is well to have a margin in all our estimates, for there is nothing that retards the progress of a novel enterprise more than exaggeration of facts, or statements which cannot be fully borne out in practice.

Some people are apt to base their calculations and estimates upon theoretical conditions. We should never assume perfection in the case of street railway tracks, but on the contrary we ought to adapt ourselves to the roughest of the rough in order to succeed.

* Read before the American Institute of Electrical Engineers, Sept. 20, 1887.

TRACTIVE FORCE AND MECHANICAL RESISTANCES.

We know from experience that street rails which are exposed to dirt, grit, stones and the like, offer a resistance of at least 20 pounds per ton with the wheels in motion. Taking the loaded car at six tons, and the speed at six miles an hour, we have to exert 1.92 h. p. at the driving wheels, neglecting friction of gearing and losses in the electric motors. On narrow grooved rails, as used in England, we allow a tractive force of from 25 to 30 pounds per ton. These high resistances are readily accounted for when it is considered that the flanges of wheels frequently take a bearing on the dirt in the grooves; at the same time the wheel tires may roll on the surface of the rails, when a regular grinding action is produced. Furthermore, it occurs frequently that one wheel is running on its proper bearing surface, while the other, belonging to the same axle, has its flange touching the bottom of the groove, when by virtue of different circumferential velocities, additional friction is introduced. Sometimes the rails are a little out of gauge. All these points increase the tractive force requisite with grooved rails. Here in America you have few if any such rails; consequently the facilities are superior; but your rails are not so strong as those used in England and on the continent of Europe, and the foundations are less substantial. The joints are also somewhat irregular, and these faults render the motion of a car very unsteady. A ride on some of the roads in Philadelphia reminds one of a voyage on the ocean when the sea is a little rough. Then you crowd very often 70 passengers into a car which is supposed to hold about 30. All these circumstances compel us to provide plenty of power in order that every obstacle can be overcome.

The force necessary for starting a car is, of course, much greater than the force required for maintaining a uniform speed, and experiments show that this initial effort amounts to three times and even four times the tractive force of the car in motion. In dry weather, on curves of 50 feet radius, the resistance to traction is doubled, and on those of 35 feet radius trebled; but when the rails are wet this resistance, due to curvature, is considerably reduced. With a short wheel base, or, better still, with small trucks or radiating axles, the motion on curved rails is very much easier.

GRADIENTS.

The effect of gradients is a matter of simple calculation, and it must be provided for in designing and constructing a motor. We have calculated above, that the minimum effective power for a six-ton car running at six miles an hour on the level is nearly two horse-power, exclusive of gear friction or any other waste. If we have to overcome a gradient of one per cent., for instance, the resistance due to gravity will be 22.4 pounds for each ton, or 134.4 pounds for the loaded car. Therefore we shall require about four horse-power to pull this car up a grade of 1 in 100. With a two per cent. grade we must have about three times the power used on level roads, and, roughly speaking, each per cent. of grade involves as much energy as the propulsion of a given weight over a horizontal road, if the speed is to be kept constant. On steep grades, however, it is customary to run a little slower, whereby some of the energy is saved; but for a car of the above weight, if it has to overcome grades of four per cent. it will not be safe to have less than eight horse-power available upon the driving axles. In addition to this the motor has to supply the power which is unavoidably wasted in the gearing used for transmitting motion from the armature shaft to the car axle. An ordinary street car wheel of 30-inch diameter has to revolve at least 77 times in the minute, in order to traverse a distance of seven miles an hour. Up to the present time no one has succeeded in constructing an electric motor of reasonable dimensions, weight and efficiency to work at such a low speed. Most of the existing motors revolve at from six to twelve times the above velocity ratio, therefore it became necessary to introduce speed-reducing appliances between the motor and the driving axles.

GEARING.

The problem of devising suitable gearing for street cars carrying their own motor has been and is still one of the greatest importance, and I propose now to offer a few remarks with reference to this subject, by citing some examples which came under my own observations. The conditions to be satisfied are by no means simple, and it is somewhat difficult to arrange them in their order of merit. Most engineers endeavor to retain the recognized dimensions of street cars, because great deviations therefrom involve many inconveniences, and it is wise to adhere as much as possible to the rules which have been established by custom, convenience and general utility. The fact that most of the street cars in all parts of the world are similar in shape, indicates forcibly that a particular pattern satisfies the demand. When taking that popular pattern of car and adapting it to our electrical and mechanical apparatus, we find that the space at our disposal underneath the floor and between the axles is meagre and extremely limited. Within this small compass we have to fix the gearing which has to give the highest possible return of a given power; it has to be strong, durable, yet light in weight; noise and vibration have to be carefully avoided; the mechanism must be simple, certain in its action; protected from wet and dirt, and finally, of reasonable cost. How to combine all these virtues has been the study of every engineer who has made electrical traction his serious study.

STEEL SPIRAL CORDS.

In regard to my own observations, one of the prettiest kinds of gearing in actual use is that on one of the cars of the Berlin-Lichterfelde Electric Tramway, which was constructed six and a half years ago by Messrs. Siemens and Halske. This car has a capacity for 24 passengers; it weighs when empty 3.2 tons and has a speed of 12 miles an hour. The electric motor is fastened under the floor in the centre of the car, having its shaft parallel to the axles. On the motor shaft is a small cast-iron pulley, which has 27 V-grooves on its rim, and within these grooves work an equal number of spiral wire ropes, which transmit the motion to both axles of the four-wheeled car. The axles carry the large pulleys, one of which has 13 V grooves on its circumference, and the other 14 grooves corresponding with those on the pulley on the motor shaft. The wheel base is five feet nine inches, consequently there is only a

distance of two feet ten and a half inches between the centres of the connected pulleys.

The ropes are made of a pair of steel wires wound closely upon a mandrel of about one-eighth of an inch in diameter, and when this mandrel is withdrawn there remains a stiff, yet flexible spiral, whose external diameter is scarcely $\frac{1}{16}$ of an inch. When cut to the proper length these cords are stretched over the grooves and connected at the ends by means of steel eyes and a steel link. Experiments made with this gear showed that eight spiral ropes sufficed for transmitting the power to the axles when the car was full of passengers, and as there are actually 27 cords the margin of safety was deemed more than sufficient. It is a pleasure to ride on this car; there is no noise or vibration, and I was told that the spirals last a long time if carefully adjusted; but this method of transmission is not sufficiently positive to warrant its application on steep grades. On this line there is no grade of over one per cent. rise.

CHAIN GEARING.

The second car on the Lichterfelde tramway, which, by the way, must be regarded as the oldest line in the world, as far as continuous successful operation is concerned, has chain gearing. The motor shaft is provided with a small toothed wheel, and one of the axles carries a large wheel with teeth to correspond to the gaps in the pitch chain links. This mode of transmission causes some noise and vibration, and this car runs slower than the other with the same amount of energy. This is accounted for by the greater friction on the surface of the teeth, as well as by the bending and unbending of the link joints; there is, besides, a constant probability of the comparatively heavy chain being thrown off tangentially by centrifugal force. But this kind of gearing furnishes an absolute or positive motion, which cannot be relied on in methods depending upon frictional adhesion alone.

Some four years ago I applied two pitch chains, four toothed wheels and countershaft for propelling a heavy storage battery car in London. The chains were of steel and substantially made; the wheels of phosphor bronze correctly shaped. I found that the chain on the fast running, first-motion shaft rattled considerably. This chain stretched a little when the links began to ride upon the points of the teeth, and eventually broke the teeth of the small wheel on the armature shaft. Previous to that I employed some other gear, which will be mentioned shortly.

Mr. Traill, the manager of the Portrush Electric Railway in Ireland, has been more fortunate than I with chain gear, but he is not perfectly satisfied, and he is now experimenting with something else. Pitch chains are also used on the Bessbrook-Newry Electric Railway and on the Ryde Pier cars. Mr. Holroyd Smith adopted this mode of transmission on the first cars at Blackpool, in England, but he has since changed it to worm gearing, with which he is better satisfied.

CONICAL DISCS AND CHAINS.

About five years ago I had the idea that it might be advantageous to vary the speed of a car mechanically without interfering with the motor or even the supply circuit. I took out a patent for this in 1882, and applied it to the propulsion of a large street car. The motor was carried by a frame supported upon the axles by bearings and springs, to counteract the effects of vibration. By this arrangement the whole apparatus was rendered independent of the car body, and it could be easily detached. The speed pulleys consisted of conical discs, which, when placed face to face on a shaft, each pair formed between them a grooved pulley, and by shifting these discs on the shaft toward or from each other, the said groove could be made wider or narrower, as desired. Two pairs of discs on different shafts were connected by means of a chain, the links of which were surrounded by wedge-shaped pieces of leather. The cross section of this chain band was thus shaped in order to fit into the V-grooves offered by the cones. When the said discs were pressed closely together, then the band assumed a position near the circumference of the discs, but when the latter were separated, then the groove widened, the band changed its position and ran on some portion of the conical surfaces nearer the centre of the pulley. Thus the effective or acting diameter of the first motion pulley was varied at will by pressure, and the cones on the second motion shaft followed suit automatically, because the length of the band was constant, and the second pair of cones was pressed together by a strong spring. This arrangement looked very nice, but its efficiency was low; there was a great waste of power through friction, and we finally abandoned it. It worked silently; it was strong and took up little room. The band slipped often when the car was starting or mounting an incline.

STRAPS AND PULLEYS.

Mr. Volk, of Brighton, England, employs leather link belts with great success, for transmitting the power of the motor to the car axle. This railway has been in operation since August, 1883. Mr. Volk tried first, single leather belts, but they broke every day or two; then he used double belts with little better results, and some three years ago he adopted the leather link belt, which has given entire satisfaction. I have seen one of the latter which has driven a car over 50,000 miles and it was not worn out yet. These belts stretch when first put on; the bearings of the countershaft are therefore made adjustable by means of a slide whereby the slack may readily be taken up. When starting the car the belts slip a little, but this is not considered a disadvantage. There are no curves on the Brighton line, and I often wondered whether this method of gearing would satisfy the terrible pull on the very sharp curves which occur on some street railways.

Mr. Van Depoele has given a high testimony in favor of link belts of a special construction after using them for a considerable time, and running them at a great velocity. Like Mr. Volk, he attaches the motor to the car body in order to give it the benefit of the existing flexibility of the car springs. Mr. Van Depoele's link belts, I understand, are made of steel, with special bearing surfaces; they have been used on a line of his construction at Windsor, in Canada; at Scranton, Pa., he employs spur gearing.

SPUR GEARING.

There exists a variety of opinions on the subject of toothed wheels in connection with electric motors, and each opinion seems based on actual experience. I have seen spur gearing used on electric cars in Europe and in this country, and I give you freely all I know about it. The first I saw was on the Moedling line, near Vienna in Austria. The noise created there was not very great, but there was occasionally some trouble due to the untimely deterioration of the teeth. This was especially remarked by the manager of the Frankfort Electric Railway in Germany, which is constructed on precisely the same principles, with the difference that the former runs through a country district where there is much less traffic, and the rails are laid on the tops of transverse sleepers like a steam railroad; there is less dust and mud to contend with. Between Frankfort and Offenbach, on the other hand, the rails are laid through populated streets, whereby all the disadvantages of city traffic are brought into play. The gearing of the cars on this line is very noisy and it wears out quickly. The train of wheels consists of a pinion on the motor shaft having 17 teeth, which gears into a spur wheel of 56 teeth keyed upon a countershaft. On this countershaft, is a pinion of 26 teeth and this drives a spur wheel of 52 teeth, fastened to the car axle. The velocity ratio, therefore, is as 1 to 6.6, between the motor spindle and the driven axle. The armature makes about 550 revolutions when the car travels at the rate of seven and a half miles an hour. The pinions are made of hard gun metal, and they wear out in about a month. I have seen a number of rejected pinions the teeth of which were ground into the shape of a fine wedge. The spur wheels are of cast steel and they last about ten months when in continuous service. I was surprised to see these; and what with the noise, the excessive weight and other drawbacks, it made me more than ever prejudiced against such a mode of mechanical transmission on street cars. My views on this point have, however, been somewhat modified since I have been in this country. I had the privilege of being invited to assist Mr. W. Wharton, Jr., of Philadelphia, in fitting up an electric street car. There we used a set of spur gearing which was supplied by the Sprague Company. In this case the motor shaft, which runs at from 500 to 600 revolutions a minute, carries two steel pinions, one at each end of the shaft, and these pinions gear direct into two cast-iron spur wheels upon the driving axle, without any intermediate wheels. The motor is partly suspended on the axle and partly on the body of the car. We have run several hundred miles with this car under all conditions of load, gradients and weather, on some of the roughest tracks in Philadelphia, but up to this moment not a single hitch has occurred. The gearing is practically noiseless, it is efficient and strong, and I see comparatively little indication of wear. The teeth are beautifully shaped, therefore somewhat expensive, but if they last long enough, and if they do not rattle when partially worn, this expense can be ignored. This car contains, besides its usual weight, about 3,200 pounds of storage batteries; it has to mount grades of 5 per cent., and run on curves of 35 and even 25 feet radius, which means very hard work.

FRICTION GEAR.

There is something quite fascinating in friction gear; it offers the advantages of simplicity, noiselessness, and theoretically a high efficiency; but as regards certainty of action and durability, it occupies a low position in the scale of appliances for the transmission of power. The late Professor Fleeming Jenkin devised an apparatus a few years ago which he called "nest gearing," and of which great things were expected, and indeed it was regarded as the most perfect frictional gear ever invented.

Professor Jenkin arranged several rollers within a ring; these rollers were in contact with a central friction wheel which was attached to the motor, and the outer ring was connected to the driven object. It is well known that in a pair of friction wheels when running together the contact surfaces are exceedingly small, the pressure must be great and consequently there is a rapid destruction of the said contact surfaces. Now, by placing a number of rollers within a ring, not only are the contacts multiplied, but there is a perfectly balanced pressure upon all the working parts. This kind of gearing, made of the best materials and of the finest workmanship, has been applied to the telpher line at Glynde. Its efficiency was tested and found to be somewhere near 95 per cent. In the case of telpher lines the motor and its attachments is well out of reach, suspended on tall posts, therefore dust and dirt can be absolutely excluded. The energy transmitted between the electric motor and the driving wheels averaged only 1.5 horse-power, and yet with all these advantages and the great care exercised in its construction and use, this gearing refused to act after a comparatively short space of time. The experiments were watched with intense interest by all who made mechanical science their profession, and especially by those who were seeking effective means of transmitting motion from electric motors. After a number of exhaustive tests, apparent improvements and modifications, the inventors of this nest gearing pronounced it a failure, and finally resorted to chains and cog-wheels. This fact, established after prolonged and most persistent efforts on the part of a number of the smartest mechanicians, should be a warning to all the advocates of friction gear for street car propulsion.

WORM GEARING.

Dissatisfied with the results of my early experiments I resolved to give worm gearing a trial. I collected all the data I could find in text books and from other people's experience. All the different authorities agreed on one point, and that was the efficiency, or rather the want of efficiency in worm gearing. According to various statements the *loss* with this mode of transmission was put down at from 33 to 75 per cent. This seemed to me a terrible waste of power; I was then, as now, engaged in the problem of utilizing storage batteries for street car propulsion. Storage batteries were at that time in disrepute generally, and as for putting these cumbersome things upon a car, the very idea of it was ridiculed by conservative-minded men. Certain would-be experts published their views on this subject, and they endeavored to prove mathematically that the battery could scarcely hold sufficient energy to propel its own weight, and that more than 50 per cent. of the power given by the charging dynamos was lost in the process of transformation. If they had known at the time that I proposed to introduce another energy-consuming apparatus in the form of worm gearing they would have declared me a lunatic. There were, however, quite a number of extenuating circumstances which encouraged me to pursue this question. I knew, from experience, that the storage battery, if properly constructed and used, could return more than 70 per cent. of the energy expended upon it. I knew also that a certain type of cell could propel several times its own weight at a speed greater than that of a horse car.

With regard to worm gearing I found that this method of transmission was used for hoists and for actuating machine tools, and that in some cases it has been working for twenty years without requiring any expensive repairs. During all my researches I failed to discover any reliable data on the construction and use of a worm which had such a steep thread that the worm-wheel could cause it to revolve. I did not come across any publication with figures to show the efficiency of gearing where the worm-shaft revolved at a very high velocity while transmitting considerable power. Just at that time the valuable researches of Professors Thurston and Kimball and Mr. Beauchamp Tower, on the subject of friction and lubrication, were published, and these revealed the fact that all the long-established laws on friction were entirely wrong. The experiments of these scientists proves conclusively that the coefficient of friction varied with the velocity, and that it decreased up to certain limits, with an increase of speed between lubricated surfaces.

Furthermore, it has been demonstrated that the coefficient of friction between lubricated bearings is not .1 or .2, as so frequently stated in text books, but .003 and less, and that even with moderately bad lubrication it amounted to only .01. All these and other considerations encouraged me in the belief that there is a fruitful field for further investigation, and I designed a set of worm gear of the following dimensions: Steel worm, turned and polished, 6 inches in diameter, 6 inches long, treble thread of 2 inches pitch; worm wheel of phosphor bronze, trimmed teeth, $15\frac{3}{16}$ inches diameter, $3\frac{1}{4}$ inch face, 24 teeth. Ratio of gear, 8 to 1. The worm was fitted to the spindle of an electric motor, and the worm wheel attached to the axle of a street car, which was supported on a frame with bearings to keep the wheels off the ground. When running empty, with the worm out of gear, the motor took 6 ampères of current, and when put in gear, but without any other load, 7.75 ampères were used to drive the apparatus at the same speed. Prony brakes were then applied to both the motor shaft and the car axle, and the power was measured on each at a given E. M. F. current and speed. The efficiency of the gearing was calculated by dividing the horse-power given off on the axle by that measured on the worm shaft, and we found that the useful effect increased with the speed, viz.: at 300 revolutions of the worm it gave 80 per cent.; at 530 revolutions, 81.1 per cent.; at 676 revolutions, 85.1 per cent., and finally at 770 revolutions, 87 per cent. These results were then compared with the electrical energy supplied to the motor in each experiment and they were found to correspond very closely, after the usual electrical losses in the motor itself were deducted. The mechanical horse-power was thus checked by the electrical horse-power, and at last I applied the well-known formula for the efficiency of worm gear, which is given in every book on mechanical engineering.

$$\xi = \frac{\cot\theta}{\cot(\theta - \Phi)} = \frac{1 - \mu\frac{p}{2\pi r}}{1 + \mu\frac{p}{2\pi r}}$$

Where θ is the angle of the worm thread,
μ the coefficient of friction,
r the radius of the worm, and
Φ the angle of repose between metal and metal,
ξ gives the efficiency of the pair.

If the coefficient of friction is taken at .015, then the efficiency must be 87.5 per cent.

By means of the above tests and the formula we can find the coefficient of friction for the various speeds.

When this apparatus was attached to the car, I found that it required less current to propel it than it did previously with the chain gear, therefore I adopted worm gear ever since. Mr. Holroyd Smith tried it recently on his cars, as already stated, and he told the meeting of the Society of Arts, in April last, that he "found it the most effective mode of transmitting the power from the motor spindle to the axle, taking all points into consideration."

With these remarks closes a short and incomplete chapter on gearing. There are other kinds of gearing which I have not touched upon. I cannot do better than to leave the subject in the able hands of members present, who, I hope, will supplement, criticise and amend the observations herein set forth, and thereby add to the general knowledge of one of the most important topics of the day. We are continually advancing; every hour marks a step forward in the direction of success. The grand general principles of the electrical transmission of energy are now well understood, but there are yet many other ways of adding to the sum of human knowledge, as for example in following up the details of construction, every one of which will add in some measure to the final triumph. Even by relating our mistakes and failures we serve a good purpose. "There are," said Professor Sylvanus Thompson, "half-forgotten observations, unconnected, unexplained, and often exceptional in character, every one of which has a significance of its own—residual phenomena, every one of which is, to the scientific man, of a value beyond price. He who investigates them patiently may find the clue to their meaning and reap a rich reward from them. They are the finger posts in the high road of discovery."

The Electric Road at Port Huron, Mich.

The subjoined interesting particulars as to the Gratiot electric road at Port Huron, Mich., operated on the Van Depoele system, have kindly been furnished us by Mr. J. H. Talbot, the manager:

"We are running a 40 h. p. generator with a 40 h. p. engine. The dynamo furnishes current for three motor cars, one car containing a 15 h. p. motor, the others each a 10 h. p. motor. Each car is able to draw a car along behind it. The current seems perfectly reliable and the motors work well. The cost of running the dynamo now is about $3.75 per day to us, as we have let it out by contract. We had some trouble last winter on account of using the rails for the return current, as the iron of the wheel and rail must come into actual contact. We know now, though, that if we can do no better, we can get the contact by fastening a

sharpened iron rod so it will scrape the rail. A great point in the way of economy is in substituting single wheel iron travelers for the elaborate ones first sent here. The expense of them is as one to twenty, and the efficiency seems equal. Our passenger receipts showed an average increase for June, July, and August, 1887, over the same months of 1886 of 65 to 80 per cent., considerable of the increase being traceable to curiosity. We carried 1,500 people a day during those months."

The Mix & Genest Microphone.

In some of the German government telephone stations which have been established in connection with the telegraph service, a new microphone is now coming into use. The leading ideas in the construction of this microphone, shown in the accompanying illustration, were, first, to avoid accidental derangement in the adjustment of the parts, and, secondly, to produce an instrument which is free from jarring noises. In the Ader microphone the carbon cylinders are loosely supported, and under vibration disturbing noises are easily produced.

The chief causes of these disturbances may be ascribed to the fact that the carbon rollers in their journals *a*, Fig. 1, rest loosely in the flutings of the beam *b*, which is fastened to the sounding board *m*. Owing to the shocks given to the entire apparatus and independent of the oscillations of the sounding board, they are set in motion and roll to and fro in their bearings.

In microphones in which the diaphragms are arranged vertically as shown in Fig. 2, these disturbances assume such a character that there is still greater difficulty in understanding the speaker, for in this case the horizontally directed oscillations of the diaphragms *m*, cause a backward and forward motion on the part of the carbon rollers without increasing or decreasing at the same time the lying-on pressure of the roller journals and by so doing bring the places of contact one on the other and thus occasion a conducting resistance of greater or less magnitude. This circumstance serves as an explanation of the reason why the diaphragms in the Ader microphones are not arranged vertically, although this way of arranging them offers many advantages.

The drawbacks just enumerated are avoided in the apparatus made by Messrs. Mix & Genest, of Berlin, Germany. A sort of braking contrivance operates on the carbon rollers in such a way as to prevent their journals from lying on the lower points in the flutings of the beams. Thus, for instance, if in a microphone with a horizontal sound plate, as illustrated in Fig. 3, the carbon rollers are pressed upward by outward force, it is evident that only a very trifling rolling and disturbing motion can occur and only small pieces of carbon can be knocked off, which would act injuriously as a secondary contact. The same may be said of the journals of microphones with vertical sound-plates, as represented in Fig. 4, when the carbon rollers are pressed in the direction of the arrow *p*, that is to say, against the sound-plate. In this case the journals *a* are fixed in the flutings of the

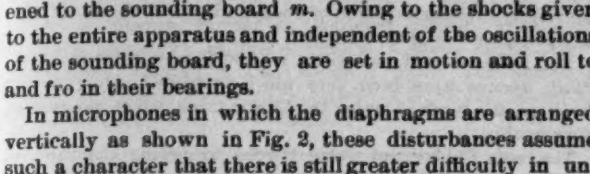


FIG. 4. FIGS. 1 AND 3. FIG. 2.

THE MIX-GENEST MICROPHONE.

beams *b* in a direction given them by the power and gravity operating on them, which is clearly represented in the accompanying diagram Fig. 4.

In all such cases the regulating contrivance applied to brake the carbon rollers in their motion, has the result that only the oscillations transmitted from the diaphragm to the contacts come in operation, whereas disturbing mechanical shocks resulting from any outward influences occasion no, or at least very insignificant, vibrations which are not perceptible in the telephone. The separate contacts thus form a firm system with the sound-plate, so that the former are influenced in their motions and effects solely by the shocks and oscillations which operate direct on the diaphragm. The rolling motion of the carbon rollers is thus removed in this way and the distinctness of the words spoken is greatly increased. This has been proved by the trials that have been instituted with this apparatus.

The construction will be clearly seen from the illustrations, Fig. 5 and 6. Between a cast iron ring *R* and the mouth-piece *T* is inserted a diaphragm *M*, consisting of pine wood, and held by the clamps *a* a^1. Upon this diaphragm are fastened two carbon holders *b b*, which serve as journals for the three carbon cylinders *k*. Across the face of the diaphragm is placed a spring *f* provided with a gun metal piece *m*, to which is attached a layer of some soft material, preferably felt, such as is used for coating the hammers of a piano-forte. This layer of felt acts as a brake, and the pressure can be increased by tightening the screws *s* s^1. The resistance of this transmitter is about 4.5 ohms. The primary coil contains 250 turns of 20 mils wire having a resistance of 1 ohm, while the secondary coil contains 2,900 turns of 5 mils wire having a resistance of 200 ohms. We may state on the authority of Herr Grawinkel, one of the officers in the administration of the German telegraphs, that speech by means of this microphone is transmitted very clearly and sharply to a distance of 120 miles over an ordinary iron telegraph wire, and to a distance of 15 miles through an underground cable.

Failure of the Government Telephone Suit.

At Boston, on the 26th inst., Judges Colt and Nelson, of the United States Circuit Court, rendered a decision in the case of the United States against the American Bell Telephone Company and others. This was the celebrated suit brought for the purpose of canceling two patents granted to Mr. A. G. Bell, relating to the art of transmit-

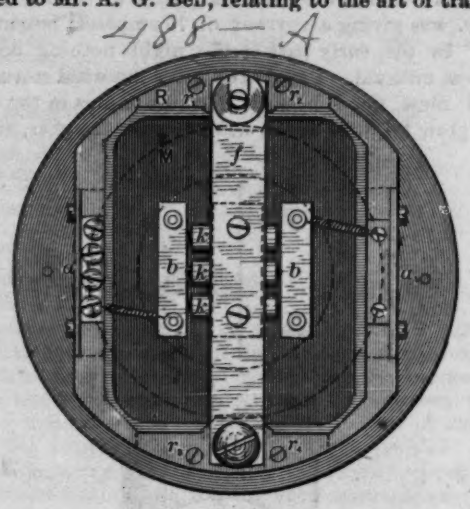


FIG. 6.—THE MIX-GENEST MICROPHONE.

ting speech by electricity, on the ground that they were obtained by fraud.

The prayer of the Government's bill was that the court would decree that said patents are and have been since the date of sealing and delivery null and void; that they were wrongfully procured to be issued by means of fraud, false suggestion, concealment and wrong on the part of Mr. Bell, and that the American Bell Telephone Company may be perpetually enjoined from making use of any right or claim under said letters patent, or from alleging the same in any court within the United States as evidence of any grant or right conferred on Mr. Bell.

The decision remarks that the first and principal question raised by the demurrer to the bill is whether, in the absence of any specific statute, the United States, by direction of the Attorney-General, can maintain a bill in equity to cancel a patent for an invention, and this question is one by no means free from difficulty, the decisions in the few cases where the point has been raised being in conflict. Upon consideration the court concludes that the carefully considered decision of Judge Shepley, of this circuit, in Attorney-General against Rumford Chemical Works (2 Bann and Ard, 298) to the effect that the Government, in the absence of any express enactment, has no power to bring a bill in equity to cancel a patent is sound, and should be followed by this court in this case. Our whole patent system rests upon a constitutional provision, Article I., Section 8, and the statutes passed by Congress. That body could have provided that the Government should have the right to bring suit to cancel a patent for an invention on the ground of fraud, but it has not seen fit to incorporate such a provision into the patent laws, and that is a sufficient answer to this bill.

The decision then reviews the various acts of Congress relating to this subject, and says that it thinks that the whole history of patent legislation under the Constitution tends to show that Congress never intended this power to be exercised under the present law, which is found in the act of July 4, 1836, which established a Patent Office, with a commissioner, chief clerk and examiners, and directed them to examine all applications for patents, and to grant only those which possessed the elements of patentability. In this act, wherein Congress created a complete patent system, it was deemed necessary to retain the old proceeding to cancel a patent found in the acts of 1790 and 1793. After observing the working of the old law for more than forty years, Congress deliberately eliminated this provision in the new act, and, it may be presumed, substituted provisions which, in its opinion, afforded better security to the public, as well as to the patentee.

The intent of Congress is further shown by the fact that, although repeated attempts have been made to amend the law so as to give some process by which an invalid patent may be vacated, the Legislature has refused to act. In the present condition of the law there would seem to be no necessity for invoking the power assumed by this bill, and the course of legislation not only fails to show any intention on the part of Congress to clothe the Government with this power, but rather goes to show its intentional exclusion.

The statutes giving the Government certain powers over the public lands are not applicable to patents for inventions. In the case of land the Government is the owner of property, and if that property is fraudulently conveyed it has the same right as individuals to recover it back. Its rights and remedies are the same as those of a private citizen in such a case. But in issuing letters patent for an invention, to quote Judge Shepley, "nothing is granted which belonged before to the United States. The issue of letters patent is in compliance with an act of Congress. The rights and remedies of the parties are dependent solely on the statute enactments, and do not grow out of any previous ownership of the supposed subject of the grant, as in the case of a conveyance of lands."

Coming finally to a discussion of the cases bearing on the question of the power of the Government to bring this suit, the decision says that it would seem from the language of the court in the decisions in the cases applicable, that if this power exists its exercise should be limited to cases where the statutory defenses fail to reach the case, and to hold otherwise would turn patent litigation largely into the hands of the Government, which plainly was not the intention of the present law. An ordinary infringement suit would meet the case.

The opinion concludes as follows: "The necessity which might possibly arise in some cases for the exercise of this power by the Government seems to be wanting in the present case. The question of power raised by this bill is an important one, and, in view of the conflict of authority, it can only be definitely settled by the Supreme Court. It is manifestly our duty in the present case, unless clearly satisfied that Judge Shepley was wrong, to follow the law as established in this circuit in the most learned and exhaustive opinion to be found on the subject. The demurrer to the bill is sustained and the bill is dismissed."

It is said by Solicitor General Jenks that the Government will take the case to the United States Supreme Court and ask to have it advanced on the calendar.

Ripening Wines and Liquors by Magnetic Action.

For some months past experiments in the process of maturing wines rapidly in the electro-magnetic field, as proposed by Dr. Fraser, of San Francisco, have been carried on in the Viticultural Laboratory of the University of California, under the direction of Prof. E. W. Hilgard. The wines submitted to the treatment were mostly made in the laboratory itself, and therefore positively known to be pure. The process was carried on in three-gallon glass jars sealed with paraffine, and around which there was a double coil of insulated copper wire, through which a current of from one-quarter to one-half ampère, generated by a con-

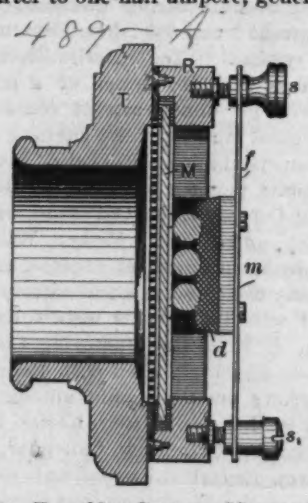


FIG. 5.—THE MIX-GENEST MICROPHONE.

stant battery, was circulated. To this influence the wine within the jars was exposed from three to six weeks at a time; the wine was analyzed at the outset, and samples of the same were kept in glass outside of the electro-treatment for comparison both by taste and analysis.

The results may be thus summarized:

The wine under treatment did not seem to deposit either more or less sediment than the sample left outside, untreated; and there seemed not to be, at any time, an appreciable difference as to clearness of the treated and untreated samples. Each time, after the second week, a notable difference in the "smoothness" of the samples on the palate began to manifest itself; it was always unmistakable after the third week, and the difference seemed to increase at least up to the fifth week. A comparison by taste indicated in every case a decrease of acidity and a more pleasant character of the acid, and the bouquet of a very much more mature wine became apparent.

Analysis of the treated wines shows, almost throughout, the following facts: A decrease of both acid and alcohol, indicating that a combination of the two into ethers has occurred, as in the natural maturing process. No appreciable change in tannin or color.

It thus appears that at least one of the processes that characterizes the usual process of maturing is very greatly hastened by the electro-magnetic treatment, and that an unmistakable improvement of the wine on the palate

takes place. Whether the wine so treated is to be considered as similarly advanced in all other respects remains to be determined by further experiments. But to the extent to which action has occurred that action may be considered as permanent.

Opening of the American Institute Electrical Exhibition.

The American Institute Annual Exhibition, in which is included the Electrical Exhibition, given under the auspices of the New York Electrical Society, was formally opened on the afternoon of September 28. The full board of managers was present, and ex-Judge Shannon, in his address, spoke of the great value of such exhibitions in bringing prominently before the public the industrial progress of the country. He referred especially to the prominent part which electricity would occupy in the present exhibition and predicted its complete success. The president of the New York Electrical Society, Mr. John M. Pendleton, being called upon, dwelt more in detail upon the progress made, and traced in rapid review the history of electricity in this country, from the time of Franklin to the present day, as exemplified in the historical and contemporaneous exhibits there present. The occasion was enlivened by music and a collation was served after the exercises.

While, as is usual on such occasions, not all the exhibits are in place, enough is already shown to indicate the character of the electrical exhibits, which occupy the whole of the rear half of the main floor. The first exhibits encountered by the visitor are those of the C. & C. Electric Company and Sprague Electric Railway and Motor Company, into the details of which we shall enter later on. Passing down the main aisle on the right, we encounter the new Cuttriss cable recorder in operation, exhibited by the Commercial Cable Company, which naturally attracts considerable attention. Closely adjoining this is the space occupied by the Writing Telegraph Company. In this apparatus, writing done at one end of the line is reproduced at the other. The Standard Multiplex Telegraph Company also show a complete set of the Delany and Callahan synchronous telegraph apparatus.

The electric railway, 300 feet in length, which runs along one side of the building, will soon be in operation, under the charge of Mr. W. S. Pendleton. On account of the limited room it was found impracticable to put in a full-sized street car, and hence the Daft motor "Ampère" will be run, drawing a platform passenger car.

Besides this the Daft Company will show a regular street car in their exhibit, together with other applications of their motor.

The building is lighted by one hundred arc lamps of the Ball Electric Company, driven by a Ball engine, and the Tucker Electric Manufacturing Company have a plant furnishing current to 500 incandescent lamps of the Mather system. The Clark Electric Company show a dynamo and arc lamps of a novel construction, which will no doubt attract considerable attention. Incandescent lamps are also running on the arc circuit. Electro-medical apparatus is also well represented, extensive exhibits being made by the Jerome Kidder Manufacturing Company, the Galvano-Faradic Manufacturing Company, and others. Messrs. Wilson and Hard show a fine physician's medical cabinet, and the Stanley Battery Company their new medical battery appliances.

The electric wire industry is also fully represented. The Washburn & Moen Manufacturing Company have a large case fifteen feet high filled with their various wire products tastefully arranged, and among the insulated wire concerns we find the Waring, Kerite, Holmes, Booth & Haydens, Okonite, Grimshaw, Callender, Bishop, and a number of others. Electrical journalism is also represented by the exhibits of the *Electrician and Electrical Engineer* and THE ELECTRICAL WORLD.

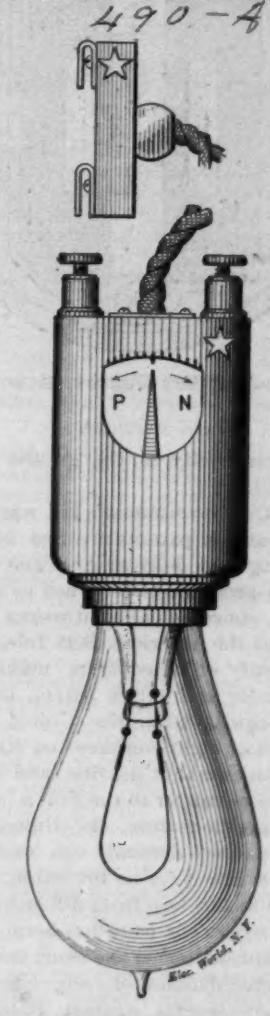
The above mentions only a few of the larger exhibitors. We hope to present a full list next week, by which time matters will be in good shape.

The historical exhibit of the New York Electrical Society has been greatly enriched by loans from the Franklin Institute, the Stevens Institute and a number of private individuals, and is a large and highly valuable collection. It includes Franklin's original friction electric machine, a piece of the first Morse message, an old Morse printer, Professor Farmer's first self-exciting dynamo machine and motors of curious construction.

A Novel Polarity Indicator.

BY L. G. NILSON.

The accompanying drawing illustrates an instrument that I have been in the habit of using and have found very convenient in testing the polarity of Edison electric light wires and meters at Des Moines, Ia. The construction will readily be understood from the drawing. The socket of the lamp contains a small galvanometer (or more properly, a galvanoscope), the needle being kept at zero by a permanent magnet so that it can work equally well in any position. The socket holds an Edison lamp which is connected with the two binding posts in such a way that the galvanometer coil and the lamp complete the circuit. When the wires to be tested are brought to the binding posts, the needle will deflect in the direction in which the current is supposed to flow, indicating positive or negative—the latter binding post being marked with the star. There is also a flexible cord attachment, terminating in two contact springs, that can be applied directly to the binding screws in an Edison meter, showing the polarity, and lighting the lamp at the same time, which is convenient where the meters are placed in dark corners.



A NOVEL POLARITY INDICATOR FOR USE ON INCANDESCENT CIRCUITS.

Effect of Storms on Electric Light Stations.

To the Editor of The Electrical World:

SIR: I see in the last number of THE ELECTRICAL WORLD an editorial on the phenomena connected with electric light stations during storms, etc., and also note your request for the experience of your readers.

I am in charge of an isolated plant at Michigan State's Prison, in Jackson, Mich. My experience occurred during a high wind storm one night last February. The storm blew up towards morning. At that time a 200-light Edison dynamo, driven by an Armington & Sims automatic engine, was giving a current of 75 ampères; potential, 96 volts. In the early part of the night nothing occurred that was unusual. But shortly after the wind storm mentioned blew up, I noticed that the lamps in the engine room grew brighter as the wind became stronger, and *vice versa*. When the potential became greater the engine increased its speed, and maintained it while the wind remained high. The pressure on the boilers at this time was constant.

The action of the engine was not such as is ordinarily seen when an engine's governor is "hunting." I am aware that much of what I have mentioned would occur had the engine been "hunting" or "spurting." The above occurred a great many times while the storm lasted and gave me a chance to observe closely, but I cannot attribute it to the engine entirely.

The effect seemed to be as if, when each gust of wind struck, it lifted a load from the engine, which would suddenly bring its governor weights and springs into action.

Michigan State's Prison. J. C. MCCABE,

A Costly Blunder.—The following story comes from Boston: Thousands of dollars were lost in State street on the 22d on account of a mistake made in transmitting the Associated Press dispatch about the government bond offer. The figures named as the maximum that would be accepted were given as $124,000,000 instead of $14,000,000. Investors and speculators of all sorts hurried to the street with early orders to buy all the local specialties and everything else at big advances over yesterday's figures. There was a wild scramble to fill orders in the first half hour, and everything went up with a hurrah. The correction did not come for nearly an hour after the Stock Exchange opened, and then those who had been deceived hastened to unload. Several local stocks went off suddenly two or three points, and there was a tremendous howl of disgust from those who got caught. The mistake is said to have occurred in the transmission of the dispatch from New York to Boston.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
NEW YORK, Sept. 26, 1887.

A few months ago, Mr. P. Maguinness asked Judge O'Gorman, of the Superior Court, to enjoin the Board of Commissioners of Electrical Subways, the Board of Electrical Control, the Mayor, Aldermen, and Commonalty of the City of New York, and the Consolidated Telegraph and Electrical Subway Company from going on with their work of digging up the streets and laying electrical conduits.

Messrs. Dos Passos, counsel for the petitioner, contended that the Electrical Subway act of 1887 is unconstitutional, and that all contracts made under it are void, because, for one reason, it was not signed by the Governor until the afternoon of Saturday, June 25 last, and was not filed in the office of the Secretary of State until the Monday following, more than thirty days after the termination of the session of the Legislature—thirty days thereafter being the limitation of time when the Governor has the power to make bills laws by signing them. The judge says he will not consider whether or not the fact that Saturday afternoon was a holiday would invalidate the Governor's signature, or at what time the bill may have been filed in the office of the Secretary of State. He holds that the certificate of the Secretary of State having been filed in his office on the thirtieth day after the end of the legislative session is conclusive upon that point.

Messrs. Dos Passos made the point also that the Subway act was unconstitutional because it authorized the taking of private property without compensation. Judge O'Gorman indorses the previously expressed opinion of Judges Allen and Freedman, that this point is not well taken.

The residents and passers by around Twenty-third street and Sixth avenue have been very much interested during the past week in the work of laying the Edison tubes, which has gone on very briskly.

The India Rubber and Gutta Percha Insulating Company, of 159 Front street, had just finished a new three-wire cable when I called in the other day. Each wire or conductor is made of nineteen No. 16 copper wires stranded together, and then covered with white gum rubber, over which Mr. Habirshaw's special black compounded rubber is put. The "wire" thus made is then taped and lead covered, after which the three are stranded together with a filler and all is covered with heavy jute tape. The company have been making three wire cables specially for the Edison underground systems in New York, Rochester and Chicago.

The well-known Edson recording and alarm gauge, made by Mr. M. B. Edson, has been put in the grand new public building, Penn Square, Philadelphia. Two have also gone in the big Palmer House at Chicago.

The American Electric Manufacturing Company took contracts from August 15 to September 20 for 836 arc lamps, and are now busily engaged installing the plants. Mr. E. H. Goff's enthusiasm and energy seem to infuse themselves into and find counterparts in the zeal of every member of the company's staff.

The Phœnix Glass Company, 729 Broadway, are making a really magnificent display of rich cut and colored glass for the new season, for arc and incandescent lighting.

I understand that the Edison Electric Light Company, after a series of tests, has recommended the Electrical Accumulator Company's storage battery to such of its sub companies as may desire to use them as adjuncts to the central station. The Edison Company has no interest, direct or indirect, in the battery, but is prompted by the desire to secure for its licensees and isolated customers all the improvements and appliances that may be demonstrated to be of practical value. It is believed that many of the Edison companies will avail themselves of the opportunity thus offered.

Mr. G. C. Tewksbury and Mr. W. Warnham will have an office at 510 Metropolitan Telephone Building, for the representation of the HillClutch Works, of Cleveland.

I have had one or two inquiries lately for Mr. J. L. Lazelle, the manufacturing electrician, formerly of 110 Liberty street. He has been away from New York for some time, but one or two of his old friends are anxious to secure his services again.

The West Coast Telephone Company has removed from 44 Broadway to 18 Cortlandt street.

Mr. J. F. Kelly, agent for the wire department of the Edison Machine Works, is said to have sold lately 40,000 yards of incandescent cord to one supply house on one order.

The Gallatin Bank, 38 Wall street, has one of the most complete isolated accumulator lighting plants in this city. It comprises an Edison machine driven by a Brotherhood engine, built by Manning, Maxwell & Moore, 111 Liberty street, and 159 electric accumulator cells 15 A type. These have run on a test 204 lamps of 16 c. p. for 12 hours. This plant was put in by the Isolated Accumulator Company, of 18 Cortlandt street, who now have 10 such plants in operation, representing 1,300 standard 15 A cells. I learn that the directors of the Gallatin Bank are very well pleased with the working of the plant.

Another use of the storage battery may be mentioned. The Saratoga Gas and Electric Light Company (American system) have put in 410 cells of electrical accumulator battery for lighting Hawthorn Springs and the stores. The arc dynamo is used in the daytime to charge the cells located where the lamps are in use, and thus the capacity of the plant is very largely increased. This storage plant was also fitted up by the Isolated Accumulator Company, and yet another specimen of their work may be seen in the lighting of the yacht "Susquehanna" in this harbor.

The New York offices of the Excelsior Electric Company have been moved from 9 Dey street to 38 Park Row.

There are several features of interest in connection with the car equipped with Julien batteries sent on to Boston by the Sprague Electric Railway and Motor Company for the West End Street Railway. It was built by the John Stephenson Company, weighs about 5,000 lbs., and is as pretty and practical a car as you could wish to lay eyes on. In attaching the two motors to the car the Sprague Company has avoided, as much as possible, changing the character of the car, or taking up any sitting or standing room. The motors, which are of a very powerful form, yet of most simple construction, are carried underneath the car. One or two motors are used, according to the size of the car and the uses for which it is intended. At each end of the motor a

bearing is extended, so as to grip the axle of the car, and is held in position by heavy iron caps; inside of these are split liners, to take up the wear. The motor is flexibly supported from the body of the car, allowing it to follow all the movements of the axle over frogs and switches without injury or disturbance. The method of gearing has already been illustrated and very fully described in your columns.

The E. P. Gleason Manufacturing Company are erecting an extension to their already large New York manufactory (181 to 189 Mercer street). The building covers 27 × 100 feet, and is to be used for increased room to facilitate the work of the electric light department, which is now one of the recognized branches of this company. In their fine new catalogue E, which the company have distributed widely to interested parties, electric light companies find many "things" that they need, and this need results in orders. The company have also enlarged the etching department at their glass works in Brooklyn, although the largest of its kind before alteration. Now, since the patent of Dec. 5, 1871, for a process of etching glass has been sustained, the works are too small. The production, when alterations are finished, will be 175 dozen etched globes and shades per day.

The brass workers in nearly all the shops in the city stopped work last Saturday at noon, in accordance with the resolution they adopted at the mass meeting in the Cooper Institute. The following are the firms where work was suspended many of them being interested in electrical work, Archer' Pancost & Co., Oxley & Giddings, Iden & Co.' Travers & Murray, Snyder & Campbell, Mitchell, Vance & Co., Bergmann & Co., Stilling & Phillips, Vosburg Manufacturing Company, Donnell & Co., Munn & Ryan, The Brooklyn Gaslight Company, Rodell & Co., Cassidy & Co., Ryan, Mayer & Co., Lathers, McLewee, and Donaldson. W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
BOSTON, Sept. 27, 1887.

Mr. C. L. Edgar, the recently appointed manager of the Edison central station in this city, has become settled in and is already thoroughly familiar with the duties of his new position.

Several gangs of laborers have been at work during the past fortnight digging trenches along many of the thoroughfares in the "West End," Boston, preparatory to putting in the Edison underground system for Central Station No. 2, now being erected on Bowker street.

The extensive hardware establishment of Messrs. A. J. Wilkinson & Co., Nos. 184, 186 and 188 Washington street, Boston, has been fitted up throughout with necessary apparatus for incandescent lighting. This isolated plant has a Thomson-Houston incandescent dynamo of 75 lights (16 c. p.) capacity, deriving its power from a 12 h. p. Payne automatic engine. The space taken up by dynamo and engine is only 9 × 9 feet. Messrs. Wilkinson & Co. keep always in stock a full line of electrical supplies for experital work and other purposes.

Among the electric light installations now going on in the State of Maine are those of Messrs. Kendrick & Davis at Lebanon, and Mr. W. K. Dana at Saccarappa. The former have nearly completed a plant with sufficient capacity (incandescent) to light their key factory and to furnish stores and residences in their neighborhood with same kind of illumination. The latter is hard at work with a large force completing an incandescent electric lighting station, which when finished will furnish lights for Mr. Dana's factory and many of the stores in the village of Saccarappa.

The Schaefer Electric Manufacturing Company, of Cambridgeport, Mass., is pushed to its utmost capacity to fill the continued rush of orders for its popular incandescent lamps. The company is enlarging its manufacturing facilities to meet the increasing demand for its product. Those who attended the National Electric Light Convention (at Boston) will readily recall to mind the handsome exhibit made by the Schaefer Electric Manufacturing Company.

The Simplex Electrical Company is moving along very quietly, making new customers and retaining its old patrons. In this way its business is having healthy, though rapid, growth, and its goods are becoming more extensively and favorably known.

At the second general meeting of the Boston Electric Club, at its rooms, No. 66 Boylston street, on the evening of Sept. 22, nearly 50 members were present. It was, in every sense of the word, a successful event. Happiness and enthusiasm prevailed, and every one present had something pleasant to say. Among the business transacted it was decided that the "house-warming" take place on the evening of Oct. 5.

The Mexican Telegraph Company has declared a quarterly dividend of 2½ per cent., leaving a surplus for the quarter of $11,000, and since Dec. 30, of $38,500.

A dispatch from Vineyard Haven, Mass., under date of Sept. 24, states that the Government cable across Vineyard Sound, which has been broken since Aug. 24, has been repaired, and telegraphic communication between Martha's Vineyard and the mainland is again established.

A Boston gentleman recently on a visit to Ansonia, Conn., makes the following statement: "The extensive shops in that town formerly used by the Postal Telegraph Company are to be placed in the market for sale."

Mr. F. T. Viles has been appointed inspector of the Western Union Telegraph Company's city line and leased wire service at Boston, the appointment to take effect Monday, Sept. 26. William F. Knowlton succeeds Mr. Viles as night chief at 109 State street.

The American Telephone Improvement Company was organized in Portland, Sept. 12, for the purpose of purchasing and holding patents of Stephen C. Drew. President, Chas. H. Drew; treasurer, Horatio N. Holbrook; directors, Chas. H. Drew, Horatio N. Holbrook, Stephen C. Drew. Capital stock, $1,000,000; paid in, $1,000,000, by assignment to the company of a certain invention of Stephen C. Drew, which the directors purchased for $999,800 in stock and $200 in cash.

The New England Wiring and Construction Company, Boston, has been awarded a contract for wiring the extension of the Adams House, in that city, for incandescent lighting; and the company will also do the wiring for electric lights in the large dining-room and entrances of Young's Hotel, in same city. The same company is receiving orders from various sections of the country for its "Regulator" oil cup, which is acknowledged to be especially adapted for use on dynamos and other machinery in electric light stations.

The opening to the public of the electrical exhibit at the building of the Massachusetts Charitable Mechanics' Association will take place this week. At this writing very few exhibitors of electrical machinery or apparatus have occupied the spaces alloted to them. The motors and shafting for power purposes are being put in. The Sprague Electric Railway and Motor Company will furnish its motors for supplying the power. The Boston Electric Light Company is rapidly pushing toward completion the wiring for furnishing both arc and incandescent lights. In my notes of next week I will be better prepared to give an interesting report of the electrical exhibits.

The Tropical American Telephone Company, Limited, will exhibit their instruments and telephonic supplies at the forthcoming American exhibition. The company has just issued a new illustrated catalogue of 50 pages for distribution.

The output of telephones by the American Bell Company for the month ended Sept. 20, and the fiscal year to date, is given as follows:

September.	1887.	1886.	Increase.
Gross output	4,110	3,800	310
Instruments returned	2,152	1,261	891
Net output	1,958	2,539	*581
Dec. 21 to Sept. 20.			
Gross output	40,651	31,761	8,890
Instruments returned	19.815	14,668	5,147
Net output	20,836	17,093	2,743

* Decrease.

The following is an interesting dispatch from Portland, under date of Sept. 22:

The annual meeting of the stockholders in the Consolidated Electric Light Company, of this city, was held at the company's office this morning. The annual report shows the business to be in a flourishing condition, with a growth as surprising to our citizens as it must be gratifying to the stockholders of the company. The company's property is located in the heart of the city, and, including the new block just completed, covers about 16,000 square feet of land. The arc light apparatus was put in by the American Company, who own a controlling interest in the plant, and the incandescent apparatus is from the Edison Company. The company light the entire city of Portland, and it is claimed that we have the best lighted city in America. It is understood that its capacity for arc and incandescent lights is soon to be largely increased and extended. Up to the present time the American Company, of New York, has been pretty much the sole owner, but it is evident from all that can be gathered to-day that a big combination has been formed between the American Company and what is familiarly known as the New Haven Syndicate. This syndicate is composed of bankers and capitalists of New Haven, Conn., who, it is said, have capital invested in electric lighting plants in different parts of the country amounting to several millions of dollars. Its operations, so far as we can learn, in New England cover the electric lighting business in Boston, New Haven, Springfield, Bridgeport, Newport and Waterbury, besides several smaller cities. The syndicate is under the management of Messrs. F. A. Gilbert, president of the Boston Consolidated Company; James English, treasurer of the New Haven, Bridgeport and Newport companies, and H. P. Frost, general manager of the Southern New England Telegraph Company. These gentlemen were elected on the Board of Directors here to-day. If this means combination with the American Company it will help to strengthen the general business of electric lighting wonderfully, from the fact that the American Company are about to move their entire factories to New Haven and double their facilities. It looks as though a combination had been made upon an immense scale. The Board of Directors elected to-day is as follows: Weston F. Milliken, William R. Wood, Franklin J. Rollins, Charles R. Milliken, Frank A. Sawyer, Portland; F. A. Gilbert, James English, H. P. Frost, New Haven, Conn.; Silas Gurney, Boston; E. H. Goff, New York.

The electric street car, equipped with Sprague motor, which was successfully experimented with in New York last week, is expected to arrive in this city to-day or to-morrow, *i. e.*, Sept. 27 or 28.

The Boston Sunday *Herald* of Sept. 25 gives the following description of the car and its experiment trips:

The Fourth and Madison avenue tracks in New York have been utilized within a few days for a passenger car of the usual size, bearing on its sides "West End Street Railway Company," intended for use in Boston. It is of the ordinary size, neatly finished, and only differing from our street cars by its higher elevation from the street. It is furnished with the Sprague motors, and the Julien storage batteries placed under the seat give to it its propelling power. Its trial trips have already demonstrated that in the near future the electric car will be adopted on surface roads. Mr. Whitney, the president of the West End, has been present and witnessed its capabilities, and has ordered the car to be sent to Boston, being satisfied that improvements which are sure to be suggested will sooner be perfected by practical tests on our streets than by short experimental trials. The car moves very smoothly, ascends the grade on Madison avenue and Fourth avenue with great facility and is stopped quicker than the ordinary horse car. It has run as high as fourteen miles an hour with the greatest ease. A second car to be constructed will have improvements on the first car, and there cannot be much doubt of the complete success of this new motive power. The present car is capable of being run forty miles with its force of batteries.

A remarkable little engine is now being manufactured in New Britain, Conn. The noticeable feature of this engine is its small dimensions when compared with the given horse-power. The Boston *Commercial Bulletin* of September 25 refers to the engine in the following manner:

The Case Engine Company of New Britain, Conn., started up last Saturday the first engine made since the company was organized. It is of 20 horse-power and is set up in their own shop for running their machinery in place of the 10-horse engine made by Mr. Case in Bristol, and which has furnished power until the present time. The outline of the 40-horse engine, just prepared by Mr. Case, the inventor, takes the following remarkably sma dimensions in inches, 9x14x35 outside measure.

The same paper thus refers to a water-wheel which is becoming extensively used in the electric lighting field: The Holyoke Machine Company, Holyoke, are running extra time with a larger force of men than they had last year. They are at work on or have recently shipped Hercules water-wheels as follows: A 500 h. p. to the Augusta Electric Light Company, Augusta, Ga.; one 250 horizontal wheel to the Winsted Gas Company, Winsted, Conn., and another of the same size to Otis Company, Ware, Mass.; two wheels of 260 h. p. capacity for Lonsdale Company Lonsdale, Mass.; six wheels to the Patten Paper Company, Appleton, Wis.; and they have just set a 325 h. p. for the Farr Alpaca Company, Holyoke, besides numerous smaller ones in different places.

The fall term of the Massachusetts Institute of Technology (located in Boston) begins next Monday. The number of students admitted in June was 238, and there are about 50 more who will take the examinations this fall. Allowing for the usual number of failures, there will be more than 250 in the freshman class, and the whole number in the Institute will be more than 775.

The Tech begins with this volume its seventh year. The board of directors will be as follows: President, H. J. Horn, Jr.; secretory, J. H. Towne; treasurer, F. W. Hobbs; Richard Devens and Hollis French. Mr. Sidney Warren will be editor-in-chief. The Technology Quarterly, which made its appearance last year, will be continued under the management of H. F. Bigelow, '88. This consists of scientific papers on the subjects of the day, written by the professors and students, and in some respects resembles the School of Mines Quarterly of Columbia College.

The Society of Arts of the Institute has issued an abstract of its proceedings, including many interesting and valuable papers, on "Steel for Warfare," "Railroad Engineering Education," "Incandescent Electric Lighting," "Domestic Manufacture of Carbonate Beverages," "Electric Welding," "Stellar Photography," "Yacht Building," "Freezing Process of Excavation," "Measurement of the Flow of Water," "Water Power of the United States," "Bessemerizing of Copper Matter," "Coal Mining," "Business Profits," "Railway Tracks," "Meteorology," "Automatic Fire Alarm," "Submarine Signals," and "Electric Distribution by Induction Coils." Professor Linus Faunce is the secretary. W. I. B.

PHILADELPHIA NOTES.

PHILADELPHIA, Sept. 26, 1887.

In speaking with regard to the suit brought by the American Telephone Company in the United States Circuit Court in Baltimore, against William C. Turnbull, to restrain him from manufacturing and furnishing to any others any telephone apparatus protected by their patents, Mr. Wharton Barker says: "Any such legal action can have no effect whatever upon our syndicate, which has received concessions from the Chinese Government. This action was probably based upon the presumption that we intended to manufacture our instruments and apparatus here, and in that case the American patents would, of course, prevent us from so doing. The patents owned by the American Bell Telephone Company of course protect them in this country or in England, France or wherever issued, but we practically hold a fifty years' patent right for China, as our grants are to that effect. We do not intend to manufacture our instruments here, and there are several good reasons why we should not. In the first place, there are the patents, which would effectually prevent us. Then we can make them in China at much less expense, as the mechanism is very simple and easy of construction, and, furthermore, if we should make them in China the Chinese would be highly pleased, while if they should be made here and carried there they would be equally displeased. Again, their manufacture there would be an aid in the development of mechanical industry there, which is just in the line of our policy. No, we are entirely beyond the reach of any such legal action. It is not strange, however, that such steps should be taken, as, in view of the enormous proportions of our enterprise, every slightest feature which could have any possible bearing upon individual or corporate interests already existing is at once seized upon. Such gigantic interests are at stake that every party likely to be in the least affected is ready to take steps for the protection of his interests."

A dispatch from Washington says: "Some very interesting trials have been recently made at the Arsenal, of the new Ullman electric annunciator target. It is a time and money saving device for rifle practice. The target can be made for rifles of any calibre and range, and the value and location of each shot striking it is accurately registered on the annunciator, which is located at the firing stand and connected by seven wires with the target. Its face conforming in every respect to regulation targets, this target is made of a solid metal plate, or of solid rings, or with the latter divided into segments. Electrical contacts are made by the motion communicated to pendulums through pins by the force of the bullet in striking."

Mr. Stephen Holbrooke, who was formerly connected with the Schuyler Co., has established himself at No. 55 South Third street, as a consulting and contracting electric light engineer. He bids upon all the different systems, and reports the business to be growing very rapidly. He has now several plants under way.

Mr. George W. Lord, of boiler compound fame, reports a splendid business in his line. Among the recent large orders received by him were some from the United States Electric Light Co., of Baltimore; the Pennsylvania Gas Coal Co., of Irwin, Pa., and G. N. Billings, of Denver, Col. They all speak highly of the compound's efficiency.

Nothing further has been heard of the Baltimore & Ohio Telegraph deal, but a sweeping reduction in salaries which was announced late last week seems to be very significant. One operator, who received $125 two years ago was cut to $80 some time since, and in last week's cut another $15 was lopped off. Another old and faithful manager of a branch office suffered to the extent of $15 on an $80 salary, and everybody else received the same kind of notice, each losing about the same proportion. There is

of course much complaint of the men at their treatment, as every one received some attention in the order for reduction.

E.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
CHICAGO, Sept. 24, 1887.

A meeting of the Chicago Electric Club was held Monday, Sept. 19, at the club rooms, 223 Dearborn street. The meeting was largely attended and enjoyed by all present. The paper for the evening's entertainment and discussion was read by Mr. E. A. Sperry upon "The protection of dynamos from lightning" (printed by you last week), and commented upon by a number of the members. Mr. Sperry illustrated a portion of his paper by apparatus. Mr. Frank J. Sprague and Mr. H. McL. Harding, general agent for the Sprague Company, favored the club with their presence and made a few remarks. Mr. Sprague has almost entirely recovered from his recent illness, and is on his way to Denver, Col., for recreation. The matter of changing the club rooms was brought up at this meeting and a committee appointed to select suitable apartments.

Mr. C. M. Barclay, the Western agent for the Sprague Motor Co., reports the recent installations of stationary Sprague motors: Elgin, Ill., three ⅓ h. p. motors; La Crosse, Wis., two ⅓ h. p. motors; St. Paul, Minn., three 1 h. p. motors; Peoria, Ill., *Democrat and Post Review*, one 5 h. p. motor; Peoria, Ill., Hill Publishing Co., one 5 h. p. motor. In this city: Myer & Goodman, 1 h. p. motor for ventilating; Lansing & Sicklers, 1 h. p. motor for ventilating; The Fair, 1 h. p. motor for driving coffee mill; American Exchange National Bank, 1 h. p. motor, driving 30-inch Blackman fan.

Mr. Jno. W. Ebert, manager of the Kansas City Telephone Exchange, paid the WORLD office a call this week. Mr. Ebert reports a continued increase in the number of subscribers at Kansas City.

The following is from a local paper: Alpheus H. Pike, a confectioner on North Carpenter street, sued Thomas L. Grenier, proprietor of Grenier's Garden, and H. F. Juleen, an employé, to recover $10,000. Juleen manages an electric organ at the garden, and has some chairs which are connected with the organ so that a person sitting in any one of them will receive a shock of electricity. Pike was so severely injured by a shock that he was laid up for a month, and he wants damages.

A test was recently made at the office of the Railway Telegraph Supply Company of an invention for which great results are promised. The test was made in the presence of Messrs. Warner and Scribner, of the Western Electric Company. The apparatus is called by the inventor an "electric combination lock." Three sets of telephone instruments were placed in circuit. When the subscriber desires to call a particular telephone in his circuit he moves the lever of a small box, similar to those used by district companies, to the number indicated, giving what is ordinarily termed "a pull." By means of the device in the lock box, only the telephone called is rung, while a visual sign is displayed with the words "in use" on all other magneto bells. While the instrument is in use no other subscriber can interfere in any manner. Where two instruments ring for connection at nearly the same time, the first one getting the current over the line shuts out all other instruments.

The magneto is turned to the right when calling and to the left to clear the line. The entire contrivance can be placed in an ordinary magneto bell. What the inventor terms the "lock box" consists of a combination wheel having an escapement that allows it to escape one or two teeth according to the duration of the pulsations. When the pulsations are made to suit the combination, the lock is at once set. The invention can be applied to telegraph lines in essentially the same manner. The inventor is Mr. E. Gill, of Chicago. A company is in process of formation to place the instruments on the market. Col. A. N. Jones, of Kansas City, Mo., will be the active head of the company.

While in Detroit this week your representative interviewed Mr. W. W. Leggett, president of the Brush Electric Light Company, and also president of the Detroit Electric Tower Company. The committee appointed by the the City Council has been in session for some time for the purpose of taking testimony upon the feasibility of putting all wires underground, and so far have heard the evidence (principally in the form of affidavits), which, of course, is favorable to the underground system.

Inquiry was made of Mr. Leggett why the Brush Company had not actively opposed the proposed legislation before the committee and presented their side of the subject.

"We have not done so," Mr. Leggett replied, "and for some reason have never been notified of any meeting, nor asked to attend. We understand, however, that the committee desired to hear the city's side of the question before calling upon us, a course which is manifestly proper, and we have felt assured that they would not take definite action until they have given us an opportunity to be heard. The committee appears to be sifting the matter with great care."

"After your return from the National Electric Light Convention at Boston, you told the committee that burying the electric light wires had been tried on F street and Pennsylvania avenue in Washington and had proven unsuccessful. What have you to say to Mayor Chamberlain's subsequent statement that he had just visited Washington and after investigating the subject had been informed by the Commissioner of Streets of the District of Columbia that no wires of any kind had ever been buried in Washington City?"

"I do not doubt for a moment but that Mayor Chamberlain correctly stated the information which he had received," was Mr. Leggett's reply, "nor do I question the good faith of his efforts to rid the business streets of Detroit of the mass of wires with which they are encumbered. Our company fully concurs in this desire and we are willing to do what we can towards seconding his efforts, but the information he gathered at Washington and the statement that was made to him were wholly incorrect. I felt personally a little embarrassed to find my statement so flatly contradicted, and apparently with such good authority, although I knew his information was incorrect, as I had personally seen and inspected the system. I have here a letter which explains the situation at Washington, and it simply establishes what the Brush Company has maintained as to the impracticable and experimental condition of the art of undergrounding electric arc light wires at the present day." The letter is from Mr. A. M. Renshaw, general manager of the United States Electric Lighting Company there.

"But what have you to say relative to the successful undergrounding of arc light wires at Chicago, which City Counselor McGrath has so well substantiated by several affidavits from that city?" Mr. Leggett was asked.

"I must simply reply again that the efforts of Mayor Chamberlain and Mr. McGrath in this direction have also failed to discover the true situation of affairs, and we do not believe that either of them, nor the City Council, nor the people generally, desire to force our company to make, blindly, an enormous expenditure of money without a reasonable certainty that the work when completed will accomplish the end sought. In other words, no one, we think, would favor compelling us to adopt an experimental system which has not yet proved practicable. In Chicago the city compelled electric light wires to go under ground. The result was, no company had the means or the courage to greatly extend its system. It resulted in the formation of nine separate lighting companies; none of them could pay expenses, and the aggregate of all their lights was a considerably less number than are now furnished by the Brush Company here. These nine companies, although for some time past consolidated into one, have now only about as many lights as our company here has at Detroit. I have just to-day received a letter from C. N. Fay, president of the consolidated company, and it fully justifies the statements we have made relative to the Chicago system.

Mr. Fay says: "The whole industry is in a very backward condition and is likely to remain so, excepting in the most densely crowded portion of the city, unless some arrangement can be made with the city authorities for overhead lines. The city is trying an experiment of its own in lighting the Chicago River, which will, I am confident, demonstrate the truth of the foregoing statement, and in the course of a year I hope that our city fathers will permit overhead lines in many places where public convenience demands electric lights, while underground construction would for bid it."

"What is the Brush Company willing to do?"

"We are willing to try a system which appears to us the best yet presented, and if the trial proves successful after a reasonable test to extend it throughout the business part of the city, if the city and the Council will second our efforts, so as not to embarrass our business in the interim."

"What system will you try?"

"Mr. De Camp, the general manager of the consolidated companies of Philadelphia, stated to the convention at Boston, that they had tried nearly everything at Philadelphia, and had had innumerable difficulties, and that nothing had yet proved successful. He also informed me that he believed no system would prove successful in which the wires lay in a duct or conduit. Mr. Brown, who had been general manager of the consolidated companies of Chicago, also stated to the convention that their experience was about the same as had been related by Mr. De Camp. I learned that Prof. Plympton had been employed by the city of Brooklyn to visit all systems here and in Europe, and reported that he found none that he could recommend as practicable for arc light wires. But after talking the matter over with many parties at the convention, especially Mr. De Camp, of Philadelphia, I concluded we might try a lead-covered insulated cable, buried in a solid mass of asphaltum, wax or other non-conducting compound, the same being laid in a shallow trench just below the paving blocks. We have considered some other systems and amongst them a very good one, devised by D. O. Paige, of the Detroit Safe Works and vice-president of the Brush Company. We have not fully decided on what system we shall try, but possibly may try both."

"Do you think that this will accomplish the purpose?"

"I do not know. I hope so, but I have many doubts about it. At any rate much is due to Mayor Chamberlain, City Counselor McGrath and the Council for pressing the matter as they have. They have at least brought us where we must face the problem with a bona fide attempt to solve it. It will be rather slow work, but in our conferences with Mayor Chamberlain he does not appear unreasonable, and wishes more than anything to compel us to make a start, with the expectation that if we succeed in clearing our wires from the streets in the course of two or three years we will be doing as well probably as could be expected of us. We regard this attitude of the Mayor as fair, and want to meet it in a fair spirit, so far as it is within our means to do so."

The only bid for electric lighting at Detroit is that of the Brush Company. It was opened last week and included the following propositions: Electric light to be furnished from 122 towers, as at present located and carrying 498 arc lights; also 121 post arc lights as at present located; and will light the City Hall and the Market building with the present number of arc lights, and substantially the same amount of gas as required this current year, or with incandescent light, as per specification, at the option of the company.

For a one-year contract, $123,463. For extra towers with four lights each, $1 per light per night if ordered before Jan. 1, 1888, and $1.25 per night per light if ordered after Jan. 1, 1888, from starting to end of contract. For extra pole lights seventy-five cents per night per light, from starting, if ordered before Jan. 1, 1888, or ninety cents per night per light if ordered after Jan. 1, 1888.

For a two years' contract, $120,215 per year. For extra towers with four lights each, ninety cents each per night per light from starting to end of contract, if ordered the first year; $1 if ordered the second year. For extra pole lights, seventy cents per night per light from starting, if ordered the first year, or eighty cents if ordered the second year. Foliage lights to burn each year from May 1 to Nov. 1, to end of contract, seventy-five cents per night per light.

For a three years' contract, $117,940 per year. Extra towers with four lights each, sixty cents per night per light from time of starting to end of contract. Extra pole lights, fifty cents per night per light, from time of starting to end of contract. Foliage lights to burn each year from May 1 to Nov. 1, to the end of the contract, fifty-five cents per night per light from time of starting. Should the Council order a foliage light to be continued as a regular pole light, the charge from that time to be fifty cents per night to the end of the contract.

Each of the foregoing bids is made with the express condition that all circuits of wire employed by the company in supplying existing public lights, or such as may be ordered during the pendency of the contract, may be overhead wires trained on poles. The company on its part agrees that it will at once begin the burying of its wires employed for private lighting within the territory lying south of Grand Circus Park to the river, and between Beaubien and Second streets, by first laying a trial system on Woodward avenue from Grand Circus Park to the river, sufficient to displace all its private light wires from poles on said thoroughfares, and should the system thus established prove practicable for the purpose, after a test extending to July 1, 1888, the company will proceed to extend the system with due diligence within the territory above described, to the end that its private light wires, save those that may be specially excepted by the City Council, may by July 1, 1890, be substantially buried within the limits mentioned. The city, on its part, must accept the foregoing in full satisfaction and compliance with existing ordinances and agree that no further requirements with respect to the undergrounding of the company's wires shall be made during the period mentioned. The city must further agree that no other party shall be permitted to supply electric light for private lighting in said territory from other than underground wires.

While in Detroit I witnessed a novel application of the electric current, which I do not believe has been put in practical operation to any extent in this country. I notice that it is mentioned by Prof. Alfred C. Garrett in his treatise published in 1861, entitled *Electro-Physiology and Electro-Therapeutics*. I refer to the extraction of teeth by electricity without pain. I called upon Dr. Younghusband, who uses this method exclusively in his practice, and was I just in time to see the apparatus in use. The doctor drew two large molars from a man of about middle age without causing the slightest pain or the movement of a muscle on the part of the patient. The apparatus consists of two electrodes which are held in the hands of the patient, the current from the positive pole being divided, one branch extending to the forceps of the doctor. A large induction coil is used, and the current can be diminished or increased as desired. The doctor has also purchased an electric dental mallet, recently described in the WORLD, and has a small motor manufactured by the Detroit Motor Company for driving a fan.

The Canadian Electrical Company, of Windsor, Ont., has been incorporated, with a paid-up capital of $150,000. The stock is held principally by Robert McKinstry, pension agent at Detroit, who holds 5,978 shares as trustee. There are twenty other stockholders owning one share each. The business of the new enterprise will consist in the manufacture and sale of electrical apparatus.

The Grosse Pointe electric railway cars building at the Pullman Car Works will be ready for delivery on Thursday, after which the time for beginning operations will be only a question of a few days.

The Woodward Electric Company has been incorporated in Michigan, with office in Detroit, for the purpose of manufacturing storage batteries. The principal elements now used in secondary batteries will be used in the manufacture of this battery, the important feature being the method of preparing the plates. The positive plates are made by pouring molten lead upon salt or other suitable substance and mixing them together in such manner that when the lead is hardened the salt can be washed out, leaving a porous plate which, it is claimed, will hold a much larger amount of peroxide of lead than the plates now in use. The company have also patents upon a process for giving the peroxide the consistency required. The inventor of this battery is Mr. Henry Woodward, late of London, England. Mr. F. B. Trout, general manager of the company, claims that the most exhaustive tests have been made and a strong company formed to place the cells upon the market.

The Detroit Motor Company are making preparations for selling their motors. They manufacture what is known in Detroit as the Fisher motor, though there is a probability that they will be prepared to furnished a style of motor designed by Henry B. Slater. Mr. C. F. Maybury, ex-Congressman from this district, is president of the company.

The Edison Illuminating Company, of Detroit, are doubling their last winter's capacity, and find it a difficult matter to keep up with orders.

They will experiment with secondary batteries with a view to the adoption of a sufficient number of cells to furnish light in case of special necessity.

I notice that the light furnished by some of isolated systems in this city is not up to the standard, the variation being very noticeable. The light is run with such a low voltage that often it will not stand comparison with gas. This is true also with a large number of isolated plants in Chicago.

Why do it?

My St. Paul correspondent sends the following:

The St. Paul Gas Company say that if they continue to do business on a paying basis they must go into incandescent lighting or give up. They express surprise at the rapid progress made by the electric light in the last few years. The fact is, that in this city the demand for the electric light is far beyond the capacity of the companies now in the business. Isolated plants are also in demand, and several representatives of Eastern companies have been in the city recently making bids. I am told that there is talk of the adoption of the Westinghouse alternating system by the St. Paul Gas Company.

At the Minneapolis Exposition there is a splendid array of electrical machinery, among which is the exhibit of the Hawkeye Electric Company, of Oskaloosa, Ia. Mr. Frank Thone, the electrician of the company, is in charge. They report a thriving business.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes me with the following quotations upon telephone stock:

Bell of Mo.	$155@$157
Central Union	44@ 45
Chicago	385@ 400
Colorado	18@ 20
Cumberland	80@ 85
Great Southern	28@ 30
Iowa Union	25@ 27
Michigan	72@ 73
Missouri and Kansas	67@ 70
Rocky Mountain Bell	40@ 45
Wisconsin	105@ 107

C. H. M.

SOUTHERN NOTES.

BIRMINGHAM, Ala., Sept. 14, 1887.

The "Magic City" of the New South has again manifested her enterprise and sound judgment by establishing one of the finest central stations for incandescent lighting to be found anywhere either North or South. The company now operating the plant was organized last winter, and the Edison system was adopted.

The contract for constructing the entire plant (with a guaranteed successful operation) was let to F. S. Marr, of Columbus, O., who brought the work to a successful termination Aug. 22, when, in the presence of a large number of the citizens, the lights were turned on for the first time, greatly to the admiration of all. Since that time everything has operated to perfection, and customers for lights and motors are rapidly multiplying.

The station building is a neat brick structure, situated on Third avenue, near Seventeenth street. It is 180 ft. deep by 50 ft. front. This is divided into offices, boiler and engine rooms. The offices and boiler-room are finished in natural woods, and present a very neat appearance.

In the engine room are four Edison dynamos, having a capacity of 2,400 lights, and two Beck automatic engines built by the Taylor Manufacturing Company, of Chambersburg, Pa. Space is left in this room for two more engines and four additional dynamos, giving a total capacity of 4,800 lights.

Three steel tubular boilers, 16 feet by 72 inches, also built by the Taylor Company, set with double return flues, water-tight ash pits, asbestos packed blow-off cocks and several other highly approved devices make up the present steam battery. The exhaust from the engines passes through a National feed-water heater.

Two Worthington duplex pumps are arranged to work either independently or together and feed the boilers through the heater or direct, thus guarding against all chances of failure in water supply.

Although it started in the face of a powerful combined gas and arc light company, the Edison Company is already assured an ample return on its investment, and if new orders continue at the present rate much longer, new machinery will have to be added.

N. M.

THE TELEGRAPH.

Cutting Down Expenses.—It is reported in Baltimore that there is to be retrenchment made in the Baltimore & Ohio telegraph system.

Steubenville, O.—The Gamewell Company has made a contract with the city authorities of Steubenville for a complete fire-alarm system.

T. M. B. A.—No assessment will be made for October by the Telegraphers' Mutual Benefit Association. Secretary Bruch announces that the annual meeting will be held in this city on Wednesday, Nov. 26.

Telegraph Earnings.—The Mexican Telegraph Company has declared a quarterly dividend of 2½ per cent., leaving a surplus for the quarter of $11,000, and since Dec. 30, of $38,500. The Central & South American Company has declared a dividend of 1½ per cent., leaving the surplus for the quarter $12,500, and since Dec. 30, $41,500.

Cable Codes.—The Official Cable Code Company has been incorporated in this city with a capital stock of $150,000. Its purposes are to print, publish and sell books, publications and pamphlets, copyrighted and owned by, or which may be hereafter copyrighted and owned by the Official Cable Code Company. A. Walter Haviland, David J. Newland, Frederick A. Linsley, James H. Hurst and Frank R. Johnson are the trustees.

The B. & O. in London.—A special cable dispatch of Sept. 24, from London, says: It is believed by those who know something of Mr. Garrett's plans that the arrangements are nearly completed for the sale of his telegraph system to Mr. Jay Gould. It is also said that the syndicate now in charge of the B. & O. properties has not yet advanced any money of its own for carrying out the preliminary agreement, but that since Mr. Garrett's last visit to London matters have assumed a different aspect, and that they will now go rapidly ahead and assume full control.

The Imperial Transpacific Cable.—A special dispatch from Ottawa, Sept. 22, says: The Government has received an intimation from the imperial authorities that the British Government cannot undertake the cost of a special survey of the route of the proposed transpacific cable between British Columbia and New Zealand and Australia unless some guarantee is given that the line will actually be laid. Under these circumstances Mr. Sandford Fleming, who may be looked upon as the father of the intercolonial cable scheme, has suggested to the Hon. Mr. Foster, Minister of Marine and Finance, that the colonies themselves should undertake the cost of survey, and he proposes that Canada's contribution thereto should be the loan of a vessel. Mr. Foster is favorably impressed with the proposal, and will at once lay the matter before his colleagues. Should the Government decide on accepting the proposal, communications will at once be had with the different Australian governments.

The Liability of Telegraph Companies Defined.—The law court of Maine has just made an important decision in regard to telegraphic messages. Fred W. Ayer, a business man in Bangor, sent a message by telegraph, and by mistake of the operator a word was left out, by reason of which Mr. Ayer was a loser, and he sued the telegraph company for the amount. Below is the decision of the court: The dropping of an important word in the transmission of a message by telegraph is prima facie evidence of negligence on the part of the telegraph company, unless explained or accounted for. The stipulation upon telegraph blanks that the company shall not be liable for the negligence of itself or any of its servants, in case of a mistake or omission in transmitting the message, unless the message is repeated at the expense of the sender, is void, being against public policy. As between the sender and receiver of a message by telegraph, any loss occasioned by a change of the terms of the message during transmission must fall upon the party who elected that means of communication for that message. Such party has his remedy over against the telegraph company, in case the error resulted from its negligence. Judgment for plaintiff for $80, with interest from the day of the writ.

THE TELEPHONE.

The Supreme Court Decision.—A special dispatch from Washington, of Sept. 27, says: It is understood that a decision in the Bell Telephone suit will be among the first to be announced on the meeting of the Supreme Court next week. The Boston case will be immediately appealed to the Supreme Court by the government counsel.

The Telephone in Venezuela.—Having received inquiries on the subject from Venezuela, Mr. J. H. Howard, the general manager of the Inter-Continental Telephone Company, writes to the papers there a pithy letter to the effect that the company still holds its exclusive concessions and is now furnishing service to 1,000 subscribers in Caracas, La Guayra, Valencia and Porto Cabello.

THE ELECTRIC LIGHT.

Mobile, Ala., is to have a plant put in by the Progressive Electric Light Company.

Columbus, Ga.—The contract for city lighting has been awarded to the Brush Company.

Orlando, Fla.—Plant is now being bought for the new electric light station of the gas company.

Pawnee City, Neb., has, it is stated, a wealthy capitalist who intends putting in an electric light plant.

Ware, Mass.—The Ware Electric Light Company has been incorporated with a capital stock of $15,000.

Amherst, Mass.—Mr. L. E. Dickinson has put a small incandescent plant in his box factory at Amherst.

Nickerson, Kan.—An electric plant is to be established at Nickerson by S. E. Newton and E. W. Elliott.

Gadsden, Ala.—The Queen City Electric Light Company is increasing its plant for incandescent lighting.

Ashtabula, O.—The water-works company at Ashtabula is to put in an electric light plant for general supply.

Vermont.—The Jones & Lamson Machine Company will probably put in an electric light plant this fall.

Nashville, Tenn.—The Nashville Ice Company have put in an electric light plant of 60 Edison incandescents.

Pensacola, Fla.—The Pensacola Electric Light and Power Company have bought machinery for their plant.

Morristown, Tenn.—The Morristown Mill Company has it under contemplation to put an electric light plant in its flour mill.

Washington, Ind.—The Washington Gas and Electric Light Company has taken a contract for 10 city electric lights at $8 per month.

New Albany, Ind.—The Citizens' Electric Light Company, of New Albany, has been organized with a capital stock of $50,000.

Carthage, Ill.—The Warsaw Electric Light Company, Carthage, Ill., has, it is stated, assigned to G. J. Rogers with $3,000 liabilities.

Albina, Ore.—An ordinance has been passed at Albina permitting the erection and maintenance of electric lighting circuits and lamps.

Dayton, Tenn.—Mr. J. Hawkins, of Tullahoma, Tenn, is interested in a movement for the erection of an electric light plant at Dayton.

Owego, N. Y.—The Owego Electric Light and Motor Company has been incorporated by J. Jones and others with a capital stock of $12,000.

Utica, N. Y.—The Citizens' Mutual Light, Heat and Power Company, incorporated at Utica by G. D. Dimon and others, has a capital stock of $50,000.

West Bay, Mich.—The House Electric Company, of West Bay City, has been incorporated with a capital stock of $25,000. Mr. F. D. Pierson is president.

Wellsville, O.—The Citizens' Electric Light and Power Company, of Wellsville, O., incorporated by E. G. Whitacre and others, has a capital stock of $20,000.

Morehead, N. C.—Mr. G. W. Blacknall, Raleigh, N. C., is desirous of getting estimates for the electric light plant to be put in the Atlantic Hotel, Morehead, N. C.

Ware, Mass.—The Ware Electric Light Company, of Ware, has been incorporated, with a capital of $15,000. Henry C. Davis is president, and Henry M. Clark treasurer.

Catskill, N. Y.—The Catskill Electric Light Company has been incorporated with a capital stock of $20,000. The trustees are M. B. Mattice, W. J. Hughes, and E. A. Chase.

Carbons.—The New York Carbon Works have been organized by H. Muller, Jr., and others, with a capital stock of $100,000. Mr. Muller is already well known in the carbon industry.

Oneonta, N. Y.—The Oneonta Electric Light and Power Company has been incorporated with a capital stock of $15,000, by H. E. Bundy, M. L. Ford, F. D. Miller, and F. Gould.

Jamestown, Dak.—It is reported that the Jamestown city council will be enjoined from proceeding with the proposed electric light plant, on the ground of previous heavy financial obligations.

Concord N. C.—The Odell Manufacturing Company are about to put in a Brush incandescent lighting plant, and the Cannon Manufacturing Company will also put the light in its new cotton mill.

Port Huron, Mich.—The Excelsior Electric Light Company of Port Huron, Mich., has incorporated with a capital stock of $50,000. The steam plant is furnished by the Ball Engine Company of Erie, Pa.

Gas Men to Convene.—The fifteenth annual meeting of the American Gas Light Association will be held in this city on October 19, 20 and 21. One of the papers to be read will be on "The Advantages of Gas Companies Engaging in the Electric Light Business," by E. J. King, of Jacksonville, Ill.

Jackson, Tenn.—The American electric light plant to be put in by the Citizens' Gas Light Company, Mr. J. Putman, secretary, will start with 50 arc lights, and will have steam capacity for 100. The plant will be ready by Christmas. Twenty-five lights will be used by the city, and twenty-five for stores, etc.

Erie, Pa.—The Edison Electric Light Company of Erie, Pa., will be ready to turn on the current Nov. 1. The capacity of this station is 5,000 incandescent lights and 300 arc lights. The systems used will be the Edison and the Brush. The steam plant is a model of beauty, and was furnished and set up by the Ball Engine Company of Erie, Pa.

West Point, Va.—The plant now being put by the West Point Water, Light and Power Company is of the Thomson-Houston system, and is of 400 lights capacity. The 80 h. p. engine was built by Seymour McIntosh & Co., of Auburn, N. Y., and the steel boiler by the Tanner and Delany Engine Company, of Richmond, Va. Mr. E. Wilkinson is president of the company. It is expected to have the plant in operation by the first week in October.

Portland, Me.—The Portland Light and Power Company, recently formed, as noted in these columns, has now completed plans for its station, which will be 42 feet wide and 18 feet front. It will be ready in about three weeks. The engines, boilers, etc., have been ordered, and all arrangements made for the installation of one of the finest plants in Maine. The Thomson-Houston arc system will be used, and an alternating incandescent plant will also be put in.

The Zipernowsky-Gaulard Proceedings.—The Civil Tribunal of Tours, says the London *Electrical Review*, has entirely rejected the action for infringement which MM. Zipernowsky, Déri and Blathy had brought against the International Electric Light Company, relating to the use of Gaulard & Gibbs' secondary generators. The value of this judgment is that it once more asserts the legal invalidity of the invention of Zipernowsky, Déri and Blathy.

The President's Car.—Supt. Robert Barry, of the Pullman Palace Car Company, has just returned to Philadelphia from Washington, where he completed arrangements for the make-up of the train which will convey President Cleveland on his Western trip. It will consist of Mr. Pullman's private car, "P. P. C.," the combination car, "Alfaretta," and the sleeping car, "Velasee." These will be all lighted by electricity, the train carrying its own dynamo for that purpose.—*Philadelphia News.*

Portland, Me.—The Portland Heat and Light Company has been organized at Portland (Me.) with a capital stock of $100,000 and the following list of officers: President, Nathan Cleaves; treasurer, Geo. F. West; directors, E. H. Davies, G. P. Wescott, F. N. Dow, Nathan Cleaves and S. R. Small. The company propose to lay wires in and under the streets of the city, and makes a specialty of furnishing power for small manufactories as well as general lighting purposes, under the Thomson-Houston patents. The wire has been ordered and the work will be pushed as rapidly as possible.—*Industrial Journal.*

APPLICATIONS OF POWER.

Ansonia, Conn.—It is hoped to have the Derby Horse Railway Company's road, operating on the Van Depoele system, ready by Nov. 1.

Omaha, Neb.—Dr. Mercer, who is interested in the Van Depoele road to be operated in Omaha, has ordered ten Pullman cars for it.

Topeka, Kan.—The Sprague Company has opened a branch office in Topeka, under the charge of Mr. W. S. Elliot, for the sale of motors.

Turin, Italy.—A Turin firm are negotiating for the equipment of a road in that city, 11.8 kilometres long, with the Van Deople system.

The Cleveland Motor Company has been incorporated at Cleveland, O., with a capital stock of $250,000, by C. A. Brayton and others.

Brooklyn.—Work is going on actively along the Van Depoele road in the outskirts of Eastern Brooklyn, and it is thought tha the road may be ready by Oct. 15.

Los Angeles, Cal.—J. H. Moon and others have secured a franchise to run an electric road by storage batteries from the Santa Fé depot to the western limits of the city.

The Baxter Motor.—The Baxter Electric Manufacturing and Motor Company, Baltimore, will, it is said, hold a meeting Oct. 8 to consider increasing their capital stock from $200,000 to $500,000. They are now enlarging their works.

Reduced Prices for Motors.—The Sprague Company announces that, owing to the increasing demand for its motors and the improvement in methods of manufacture, it has made a great reduction in the price of its machines.

Kingman, Kan.—The Kingman Street Railway Company is now trying to make arrangements with C. D. Wright & Co., of the Kingman Electric Light Company, to have that company furnish the power to propel the street cars of the city by electric motors.—*Street Railway Gazette.*

Milwaukee, Wis.—The Milwaukee Electric Railway Company has applied for a franchise to construct and operate an electric railway through several streets of the city. The Van Depoele system is contemplated, and it is to be "a popular people's line," with reduced fare, etc.—*Street Ry. Gazette.*

The Elieson System.—The Elieson electric motors on the road of the North Metropolitan Company, London, show for the last six weeks' running an average weekly mileage per car of 490 miles, 3,325 passengers per car, and 475 passengers daily. The motors are said by experts to be working most satisfactorily.

The Sprague System.—The Sprague car intended for the West End road in Boston was given some runs on the Fourth venue road in this city last week, before being sent on. The

car is equipped with two Sprague motors and with Julien storage batteries. It runs with exceeding ease and smoothness, and is thoroughly under control.

An Imported Electric Yacht.—On the forward starboard deck of the steamship State of Nebraska, when she arrived from Glasgow this morning, says the *Commercial Advertiser* of Sept. 27, was the hull of a good-looking propeller yacht, which is to have an electric motor. She is consigned "to order," but is said to be the property of one of the Westinghouses.

The Ryde, England, Electric Railway.—At the annual meeting of the Ryde Pier Company, reports the London *Electrical Review*, Mr. Gabell inquired whether the electric railway had proved a satisfactory financial speculation, and in reply the chairman stated that it had proved very satisfactory. It was one of the greatest successes the company had achieved for many years past, although he honestly confessed that he opposed it himself in the first instance. It had been carrying 3,000 persons a day for some time. A dividend of four per cent. was declared.

Detroit, Mich.—During a trip made by Mr. Frank E. Fisher on the Highland Park road, last week, with about 50 members of the Board of Trade as passengers, the car "Faraday," which has been in regular service for some time, traveled continuously at the rate of 35 miles an hour. This is very high speed for a street car, and of course would not be desirable in cities, but the road in question runs out into the suburbs. Mr. Fisher is certainly to be congratulated on the efficiency of his system, as thus demonstrated.

A Storage Car for Brazil.—Mr. Wharton, of Philadelphia, states that the Emperor of Brazil has sent an order for a special palace car for his own private use, to run upon the street railway lines of Rio de Janeiro, and that it was understood that the car was to be run by Sprague motors, driven by the storage batteries of the Electrical Accumulator Company. He said that it was a curious commentary on the widespread knowledge of the present day that the first electrical storage car of this system in practical service would run upon the tracks of a street railway in South America.—*Street Railway Gazette.*

PERSONALS.

Mr. J. Swinburne, the well-known English electrician, is now in America.

Mr. Jay Gould is said to be planning to make a trip abroad in his yacht, and to be gone some months.

Mr. Geo. Westinghouse has bought 95 acres of land between Brinton and Wall stations, on the Pennsylvaning Railroad, paying therefor about $1,500,000. It is Mr. Westinghouse's intention to erect a monster plate glass factory. He has for some time expressed a desire to enter this business, and it also was his ambition to erect the largest steel rail and general steel plant in the world with a capital of $5,000,000.

Mr. R. Percy Sellon, of the Anglo-Brush Corporation of London, is at present on a visit to this country. He is a nephew of Mr. Sellon, of storage battery fame.

MISCELLANEOUS NOTES.

Birmingham, Ala.—The Electro-Libration Company has, it is stated, been chartered by J. N. Webb and others.

A Vaporization Crematory.—A Sicilian has invented a method by which cremation is accomplished by means of electricity. It requires a dynamo like those employed for arc lights. It is stated that the effect of the intense heat is to vaporize the entire body.

Pawtucket, R. I.—The Collyer Machine Company, of Pawtucket, has under consideration plans for the erection of new works throughout. They are also experimenting with the view to introducing cheap but effective electric light plants for small shops and mills.

"Not the Same."—Our Western representative, Mr. C. H. Maclilie, is accustomed to write his name plainly, but that such is the case might seem doubtful when a dispatch from him reaches us signed "C. Hindodilia." The operator had evidently had a fearful struggle with the message.

Mt. Tom, Mass.—The Connecticut River Company, of Holyoke, has put in an electric light plant at its Mt. Tom saw-mills, as the mills are now running night and day. The dynamo is run by the engine used in the old kindling-wood mill, and eight arc lights are run in the mills and about the yard.

Electric Drawing Frames.—The Fales & Jencks Machine Company, Pawtucket, has made arrangements with Riley & Gray, of Boston, to build the Howard & Bullough's electric drawing frame, for which Riley & Gray are agents in this country. These frames have heretofore been built in Europe.

West End Railway, Boston.—The latest programme of this company is to take possession of all the Boston railroads Nov. 1. The hearing before the railroad commissioners for authority to increase the capital of the Suburban road from $50,000 to $150,000 developed no opposition. The electric car will soon be tested upon the street car tracks, perhaps on Saturday. Boston's street car service has need of an electric battery some sort to give it a shock.

Buffalo, N. Y.—In the new Grand Opera House at Buffalo one of the precautions against fire is an iron curtain coiled above the proscenium arch and ready to be dropped by the pressure of an electric button. Another feature is the opening of a section of the roof in a similar way. *Fire and Water* thinks the latter arrangement good, "and one which, if existing in any one of the theatres recently burned, would, in all likelihood, have saved a great number of lives."

American Telegraph Company.—In the action of Harland as receiver for the American Telegraph Company, and of the property covered by a mortgage or deed of trust executed by that company to the Boston Safe & Deposit Company Sept. 1, 1883, against the Bankers & Merchants' Telegraph Company and others, Judge Wallace rendered a decision in this city on Sept. 28, dismissing the bill, without costs. The main issue was to determine the priority of lien.

BUSINESS NOTICES.

Jordan & Gottfried, 208 Canal St., N. Y., carry a complete stock of iron and brass machine and wood screws, bolts cap and set screws, taps, dies, files, twist drills, brass and rubber in tubing, rod and sheet copper, brass, German silver, steel and iron wire, shafting, tools, etc.

STOCK QUOTATIONS.

The following list, compiled by Mr. W. H. Baker, member New York Stock Exchange, 16 and 18 Broad street, gives the current quotations of electrical stocks:

Sept. 28, 1887.

TELEGRAPH.	Bid.	Asked.
Am. Dist.	.....	37
Am. Tel. & Cable	70	74
Cen. & So. Am.	100	110
*Com. Tel	.....	.....
*Gold & Stock	.....	.....
*Inter. Ocean Tel.	.....	.....
N. Y. Mutual	70	80
Pac. & Atl.	49	56
*Postal T. & C.	30	.....
South. & Atl.	72	80
W. U. Tel.	74¾	74⅞
W. U. Scrip	.....	.....
W. U. Bonds	117	.....
Mut. U. Bonds	84½	85
TELEPHONE.		
Am. Bell	223	224
Am. Speaking	105	115
Erie	33⅓	34
*Hudson River	.....	58

TELEPHONE.	Bid.	Asked.
Mexican	¾	1
*N. Y. & N. J.	.....	.....
N. Y. & Pa.	.....	.....
New England	41	42
*Southern Bell.	.....	.....
ELECTRIC LIGHT.		
*Am. Electric	40	45
*Brush	42	48
*Brush Ill	.....	97
*Consolidated	4	.....
*Daft	.....	.....
*Edison	130	150
*Edison Ill	85	.....
*Edison Isolated	.....	.....
*United States	.....	55
*U. S. Ill	84	.....
MOTOR.		
*Daft	.....	.....
*Sprague	.....	.....

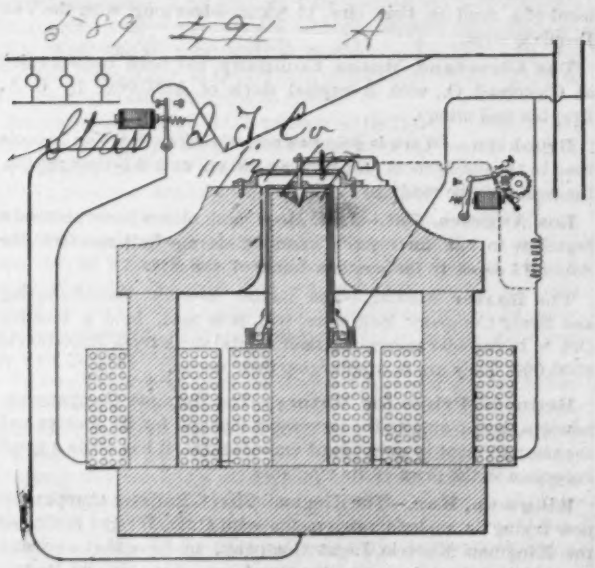
* These stocks are so seldom dealt in that it is difficult to give prices at which they can be bought or sold. The figures given are as near as can be ascertained.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED SEPTEMBER 20, 1887.

370,052. Signal and Pyrotechnic Electric Light; A. C. Ferguson, Saratoga, N. Y. Application filed Dec. 22, 1886. By means of a suitable switching device carbon electrodes arranged to form some figure are rapidly flashed so that the image produced on the eye is of the figure previously arranged.

(1) 370,123. Electric Meter; (2) 370,124. Manufacture of Filaments for Incandescing Electric Lights; (3) 370,125; (4) 370,126; (5) 370,127; (6) 370,128; (7) 370,129; (8) 370,130; (9) 370,131. Electrical Transmission of Power; (10) 370,132. Telegraphy. T. A. Edison, Menlo Park, N. J. Applications filed as follows: (1) April 17, 1883; (2) April 20, 1883; (3, 4, 5, 6, 7, 8 and 9) June 7, 1883; (10) May 15, 1886. (1) A motor which



370,123. ELECTRIC METER.

operates the registering apparatus has its inductive portion in the translation circuit, the electrical energy consumed in which is to be measured, the field magnets of the motor being in a multiple arc circuit. See illustration. (2) After carbonizing the filament it is heated to incandescence in a vacuum, then dipped into a solution of carbonizable material, and then the whole is carbonized. (3, 4, 5, 6, 7, 8 and 9) These patents all relate to the regulation of motors not connected on the same driving shaft simultaneously from a distant point, by regulating the current generated by the generators. See illustration. (10) This combination is used: (a) sets of Morse telegraph instruments consisting each of an induction transmitter producing Morse signals composed of simple induction impulses and a diaphragm sounder responding to such simple induction impulses, and (b) other sets of Morse telegraph instruments consisting each of an induction transmitter producing Morse signals composed of harmonic or rapidly occurring induction vibrations and a diaphragm sounder responding to such harmonic induction vibrations.

370,134. Secondary Battery; O. C. Flick, of Brooklyn, N. Y., Assignor to the Doane & Wellington Manufacturing Co., of New York. Application filed April 22, 1885. An oxygen

370,125. TRANSMISSION OF POWER.

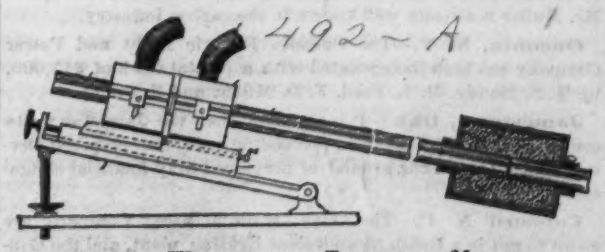
plate consisting of the peroxide of lead, and a hydrogen plate consisting of an amalgam of zinc, mercury and lead. See illustration.

370,193. Adjustable Support and Automatic Switch for Telephones; S. P. Jermain, Toledo, O. Application filed Feb. 26, 1887. This is an arrangement of brackets and swinging arms whereby the receiver may be turned in any direction.

370,230. Auditory Transmitter for Telephones; M. H. Allison, Xenia, Ohio. Application filed March 2, 1887. A diaphragm is arranged anteriorly to the telephone diaphragm, and reflecting surfaces are arranged in front of the same for concentrating the sound-vibrations thereupon and reflecting surfaces between the anterior and the regular diaphragm.

370,243. Electric Attachment for Locomotives; N. F. Chase, Montrose, N. Y. Application filed Jan. 24, 1887. By this device persons alongside a railway track may signal the engineer of a passing train to notify him of danger.

(1) 370,282. Electric Welding and Tempering Metals; (2) 370,283. Underground Conduit for Electric and other Railways; E. E. Ries, Baltimore, Md., Assignor of



370,282. WELDING AND TEMPERING METALS.

one-half to A. H. Henderson, of same place. Applications filed respectively Feb. 26 and April 29, 1887. (1) The extremities of the metal which is to be joined are placed together and a regulated current of electricity passed through them until the ends are fused and united, then tempering the joint thus formed by the application of some chilling compound. See illustration. (2) A bracket is placed transversely at suitable distances apart between the rails of a railroad. In these brackets are suitable openings to receive electrical conductors for any kind of service, including the conductor for the electric railway.

370,293. Telephone System; F. C. Watkins, of Philadelphia, Pa., Assignor by mesne assignments to the United States Krotophone Co., of New York, N. Y. Application filed Dec. 24, 1886. Two branches to the main line are provided, one of which contains a telephone transmitter and the other a telephone receiver, with a switch for connecting either to ground through a battery.

370,328. Fire-Alarm Box; B. S. Flanders, of Boston, Mass. Application filed March 19, 1887. A signal transmitting instrument is operated by a motor which in turn is started or unlocked by an auxiliary motor. The auxiliary motor is released by a magnet.

370,357. Printing Telegraph; R. J. Sheehy, New York, N. Y. Application filed March 24, 1886. An electric motor is employed to rotate the type-wheel shaft, consisting of two magnets, included in two independent line wires; the magnets

370,134. SECONDARY BATTERY.

are alternately energized, and their armatures operate the impression device.

370,366. Process of Separating Metals from their Ores; David W. Birmingham, Clifton, New York. Application filed May 4, 1886. The ore is first amalgamated and intimately mixed with mercury, then the pulp is subjected to the action of a positive current of electricity, the positive pole being in contact with the pulp, and the mercury is finally collected at the negative electrode.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had from this office for 25 cents. Give the date and number of patent desired, and address Johnston's Patent Agency, Potter Building, New York.